Radio, Electronics and Communications

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In This Issue . . .

- Atomic Frequency Standard.
- Tape Topics.
- Medical Electronics — Part II.
- Electronic Flash Slave Unit.
- Mobile Communications.
- Circuit & Service Data — 5" TV.
- Listening Post; Serviceman's Column.

PUBLISHED MONTHLY IN THE INTERESTS OF THE N.Z. ELECTRONICS INDUSTRY FOR ALL LEVELS, FROM PROFESSIONAL TO AMATEUR.

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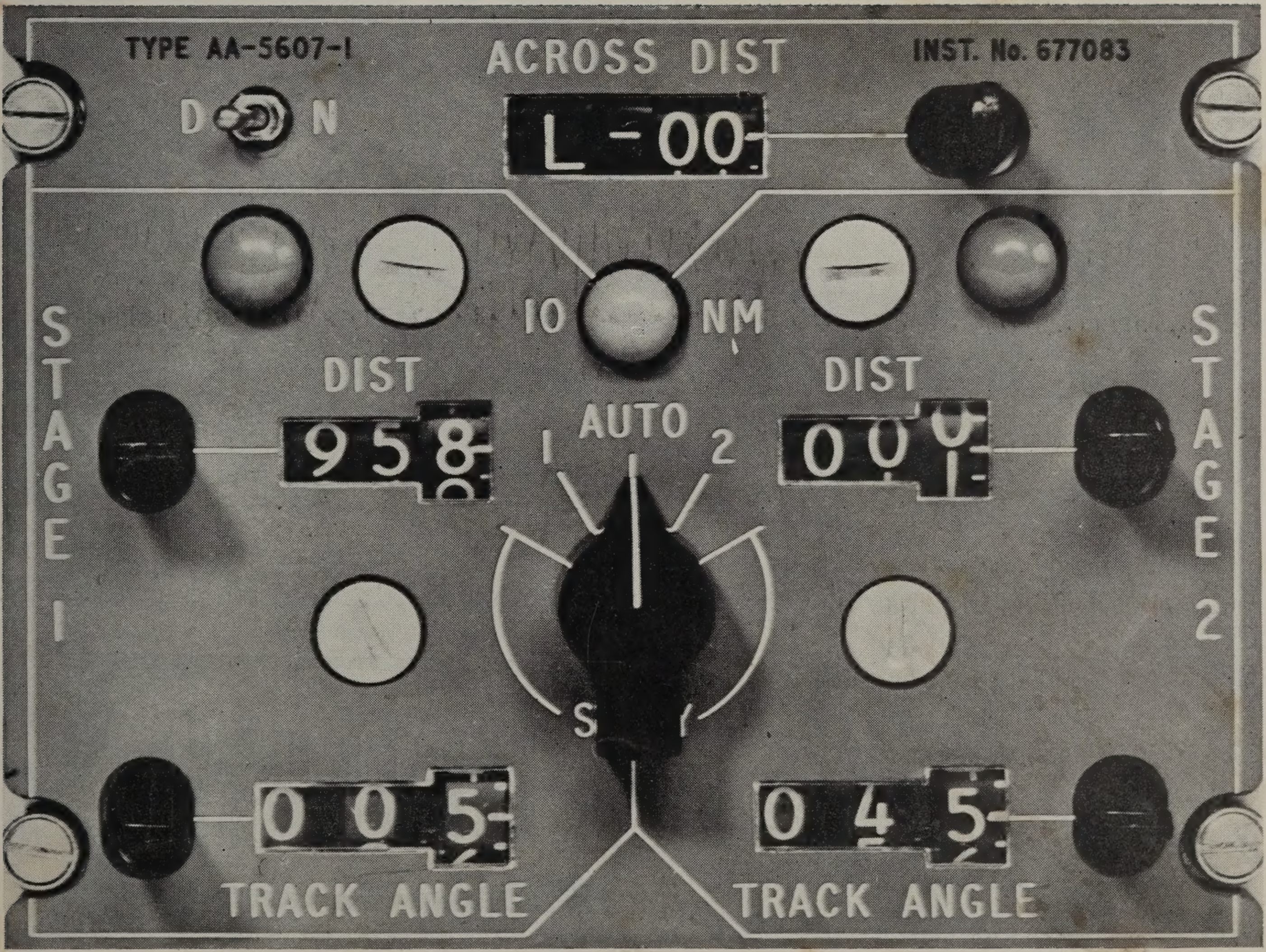

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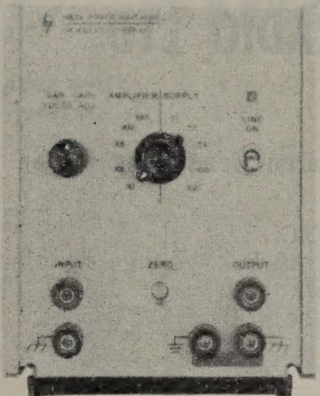

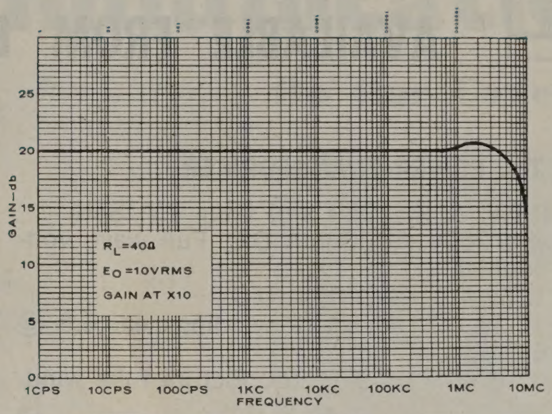

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CONSULTANT EDITORS:
C. W. Salmon, M.N.Z.I.E., Grad. I.E.E., Assoc. I.E.R.E.
I. H. Spackman, A.M.I.E.E.E.
P. L. Watts representing N.Z. Electronics Institute

EXECUTIVE EDITOR:
Robin H. E. Beckett.

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Director and Secretary:
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Production Manager:
Robin H. E. Beckett, B.A.

at the Registered office of the company, Employers Association Building, 157 Khyber Pass, Auckland, C.3. N.Z. P.O. Box 1365, Auckland. Telephone 41-508, 41-519.

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Vol. 20, No. 4 June 1, 1965

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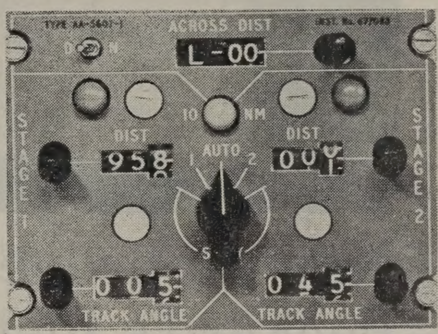
On Our Cover



Our cover this month shows the Marconi Doppler Computer Display Unit to be supplied by Amalgamated Wireless (Australasia) N.Z. Ltd., for Air New Zealand's new DC.8 jets. This unit is installed in the pilot's cockpit and co-ordinates information from the tracker and aerial units which are also part of the equipment.

Further information on this fine product appeared in the New Products section of our April 1965 issue to which readers are referred.

COMING . . .

Telemetry Systems
A Transistorcom.
The Manufacture of Telephone Cable.
Digital Electronics in Industry & Science.
Mobile Communications; Medical Electronics —continued.
Tape Topics—conclusion.
The Choice of a Voltmeter.

Also . . .

Circuit & Service Data.
Book Reviews.
Serviceman's Column.
Listening Post.
New Products.
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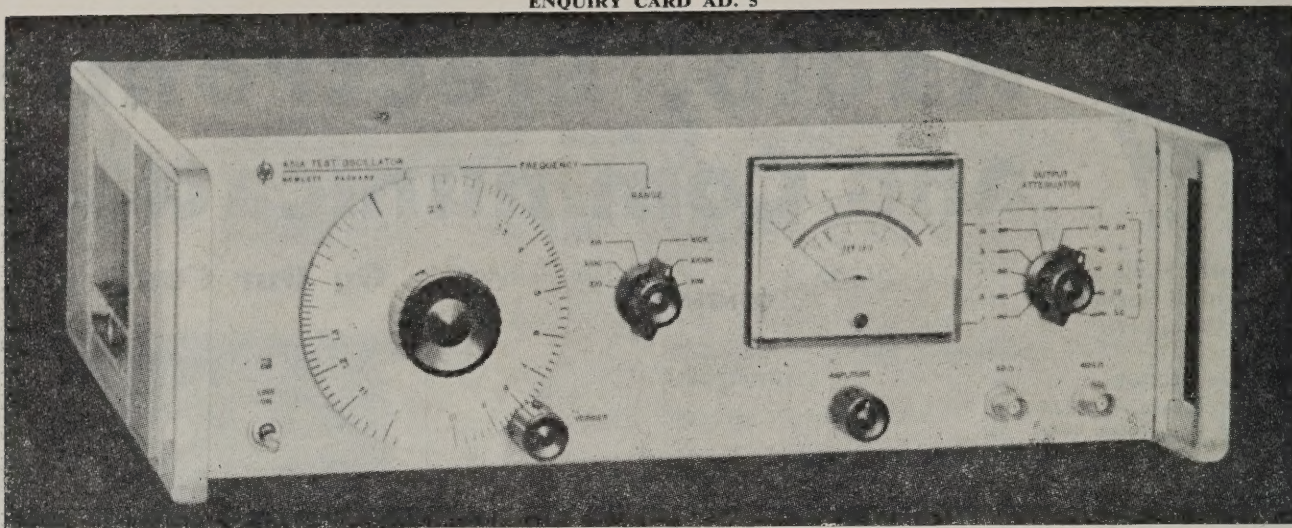
ENQUIRY CARD AD. 5



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Letters from Readers

Sir,

I was pleased to read the article by Mr. Stagpoole in the April issue of "Radio, Electronics and Communications" on the subject of the Training and Recognition of Electronics Technicians. As the Chairman of the Engineering Associates Registration Board said in a recent lecture to the NZIE, "Everyone regards himself as an expert on the subject of training" and this should assure you of a fair amount of correspondence. However, as a Radio Engineer of over twenty years standing and, incidentally, one of the State Services' Committee which was largely responsible for the introduction of the Radio Technicians' Certificate, I would like to take issue with Mr. Stagpoole on two of his statements.

Firstly, his comment that an NZCE takes about the same amount of study and time as a B.Sc. degree. The fact is that a B.Sc. takes a minimum of three years' full time at University, which means usually five years after School Certificate. On the other hand, the Civil Aviation Department Training Manual indicates that their technician candidates, starting with S.C. "level" general education (including a 50% pass in mathematics but not necessarily an overall pass), can complete NZCE in four years while at the same time spending about half their time "on the job" in the Civil Air Department workshops and half in formal study for the NZCE at the Central Institute of Technology, Petone. Concurrently, the students find time to collect the C.R.T. (in future Radio Technicians' Certificate), the Departmental examinations in Pulse Techniques and Navigation Aids, the Limited Electrical Registration and the State Services' Departmental Knowledge examination! All this is good stuff but not to be equated with a University education.

Secondly, although I would agree with most of Mr. Stagpoole's remarks on "Engineering divisions", I do not support the introduction of the term "Technician Engineer" for the New Zealand scene. This description is far from generally accepted in Britain and was put forward there only because the term "technician" has been adopted there by all sorts of unqualified people. The situation is much better in New Zealand owing to the policy of the State Services' Commission and Broadcasting Corporation in restricting its use to those with at least CRT or equivalent qualifications plus a good practical training over a fairly wide field. The RNZAF has assisted by not following the RAF in calling its mechanics and fitters "technicians". Here there is still time to establish a recognised usage such as "mechanic" or "serviceman" for the semi-skilled; "tradesman" or "fitter" for the skilled; "technician" for the highly skilled. Broadly speaking "skilled" may be taken as the level of qualifications that are controlled by the Trade Certification Board and "highly skilled" as that under the Technician Certification Authority, although there is in fact some overlap.

The equivalent of the "Technician Engineer" in New Zealand is often a "Supervising Technician" in a State Department and these are eligible for registration as "Engineering Associates". There is, however, still some need for academic and professional qualifications to bridge the gap between NZCE and BE on the one hand and Engineering Associate and MNZIE on the other.

In this connection, I would draw the attention of readers to the Institution of Electronic and Radio Engineers (late Brit. I.R.E.) which has over 7000 members, including over 100 in New Zealand with local sections in Auckland and Wellington. Their Graduateship examination can be obtained part time, normally in Britain through endorsements to Higher National Certificate and it is fully recognised as being now of degree level and equal to the Grad. IEE. (In New Zealand moves are under way for professional, IERE, courses to be conducted by the Technical Institutes, more particularly at the Auckland Technical Institute Ed.). In addition to Graduates, there are three grades of membership including "Associate" which is open to those who have responsible positions in the profession but who haven't the right "pieces of paper", and Associate Members who have both the academic and professional qualifications needed for Corporate Membership in an Engineering Institution.

The Royal Navy is one of the many organisations which accept the Grad. IERE (or IEE) as an alternative to a University degree, and for their short service electrical engineer officers actually conduct a course at the R.N. College, Greenwich which leads to the Grad. IERE. At the same time, they run a course at Manadon for their long service officers leading to an external B.Sc. (Engineering) honours degree of London University. The RNZN has officers on both these courses and there is little difference in their standards except that the honours degree takes two terms longer and is that much further advanced. The Grad. IERE has not always been so well recognised, especially by the NZIE but since it received a Royal Charter and became one of the thirteen Institutions in the Engineering Institutions Joint Council, it has become definitely respectable. I must admit I have thought it to be under-rated ever since I joined it in 1946!

For the technicians, the IERE has recently sponsored the Society of Electronic and Radio Technicians which has got off to a good start but in New Zealand we have a perfectly good and very active N.Z. Electronics Institute covering much the same ground. Perhaps some sort of link or affiliation between these two might be worth serious consideration?

G. M. BEERE
B.Sc., M.I.E.R.E., M.N.Z.I.E.
Commander, R.N.Z.N.

The comments of our correspondent form a most interesting follow up to the earlier article. These views from one of wide experience clarify many aspects of the qualifications and their relative status.—Ed.

We have not overlooked a reply to the letter re our editorial "The Axe Grinders"—it is coming.

Looking at Ourselves . . .

An estimate of the vitality and potential of a publication is based on a barely-definable combination of qualitative and quantitative factors concerned with the levels of editorial content, production, circulation and advertising. These fields must be valued overall in relation to the state of the particular reading market.

The New Zealand Electronics Industry is at present vitally and somewhat apprehensively concerned about its future. The industry has for some time been frustrated by import restrictions on many components and instruments, but has during the past few years been sharing in the very profitable introduction of television to a virgin market. However, this source of revenue is shrinking as a large slice of the demand becomes satisfied. It seems inevitable that production of both television and radio for the consumer market must level out far below the peaks of the last few years. Considered objectively, the hoped-for saviour—colour TV—still seems a long way off and the introduction of a second channel — when it comes — will be of some value, but will not by any means solve the problems of the industry. There must be a change of emphasis within the industry and most manufacturers, large and small, should be planning for this. The end result would appear to be greater concentration on industrial and commercial problems, control equipment, communications and similar fields.

This trend must inevitably result in the industry and R. E. & C. being thrown more closely together, since the potential of our already strong medium is going to become more widely recognised, as even greater emphasis is thrown on fields that we have been serving over the past few years.

In May 1964, we decided that in pursuit of our stated aim of moving with the times, a change of name was required—hence ''Radio, Electronics and Communications'' emerged. The reception given the magazine in the past year has proved the wisdom of the move. This change brought an end to the teething problems of the previous three years and introduced a period of accelerated progress. The tempo of our activities has grown month by month to a point where it is obvious that the industry values our efforts.

Readers do not wish to be bored with a recapitulation of achievements. However, certain observations warrant making, especially in view of plans for the next twelve months. The basic aims for a magazine are, naturally—

To provide good reading matter, thus, increasing circulation among the right readers and, increasing support from satisfied advertisers. These factors are dependent on the standard of editorial—this must be of ever-improving quality, with increasing sources, types of material and quantity.

Our circulation has continued to grow and expand its spread amongst the diverse groups for which we are trying to cater: from the lowliest schoolboy at the outset of a career, to the highest-ranking expert. Our index of advertisers has increased, while the quality of their advertisements has improved to an agreeably high level. The unifying aspect between readers and advertisers—editorial—has been maintained at a level which has been instrumental in our expansion. Whilst acknowledging the undoubted scope for further improvements, it can nevertheless be claimed that there has been notable progress in the range of articles, presentation and illustration.

Of importance to all interested in the magazine's development will be the news that May 1965 saw a doubling of circulation in Australia. Plans are under way for circulation promotion, which it is hoped will lift our total readership from just under 3000 to substantially over the three thousand mark. This is aimed at specialist group in Government Departments, Power Boards, Hospital staff, radio servicemen and industry. The logical next step is a readership survey, to provide a statistical breakdown of classes of readers, and other information. We hope that this can be implemented early in 1966.

In the field of advertising there seems every likelihood of increased support as competition in the industry grows and the power of the magazine is more fully appreciated. The improved standard of advertisement copy itself is a major factor in the appeal of R. E. & C. to readers.

The volume of our editorial is dependent on this growth of advertising, but our aim is to increase the number of pages, as soon as economically possible, to forty-eight or fifty-two. Subsequent increases must inevitably depend on revenue. We feel strongly that R.E. & C. now represents a valuable forum for the presentation of the wide variety of electronic activities being undertaken in New Zealand. The continued strength of the editorial demands a constant flow of original material. The work is definitely being done. It is in the hands of our readers whether or not these achievements are presented for publication.

We are confident that in mid-'66 further progress will be reported. In pursuit of our aims, we need the continued support of individual readers—and look forward to even more of you.

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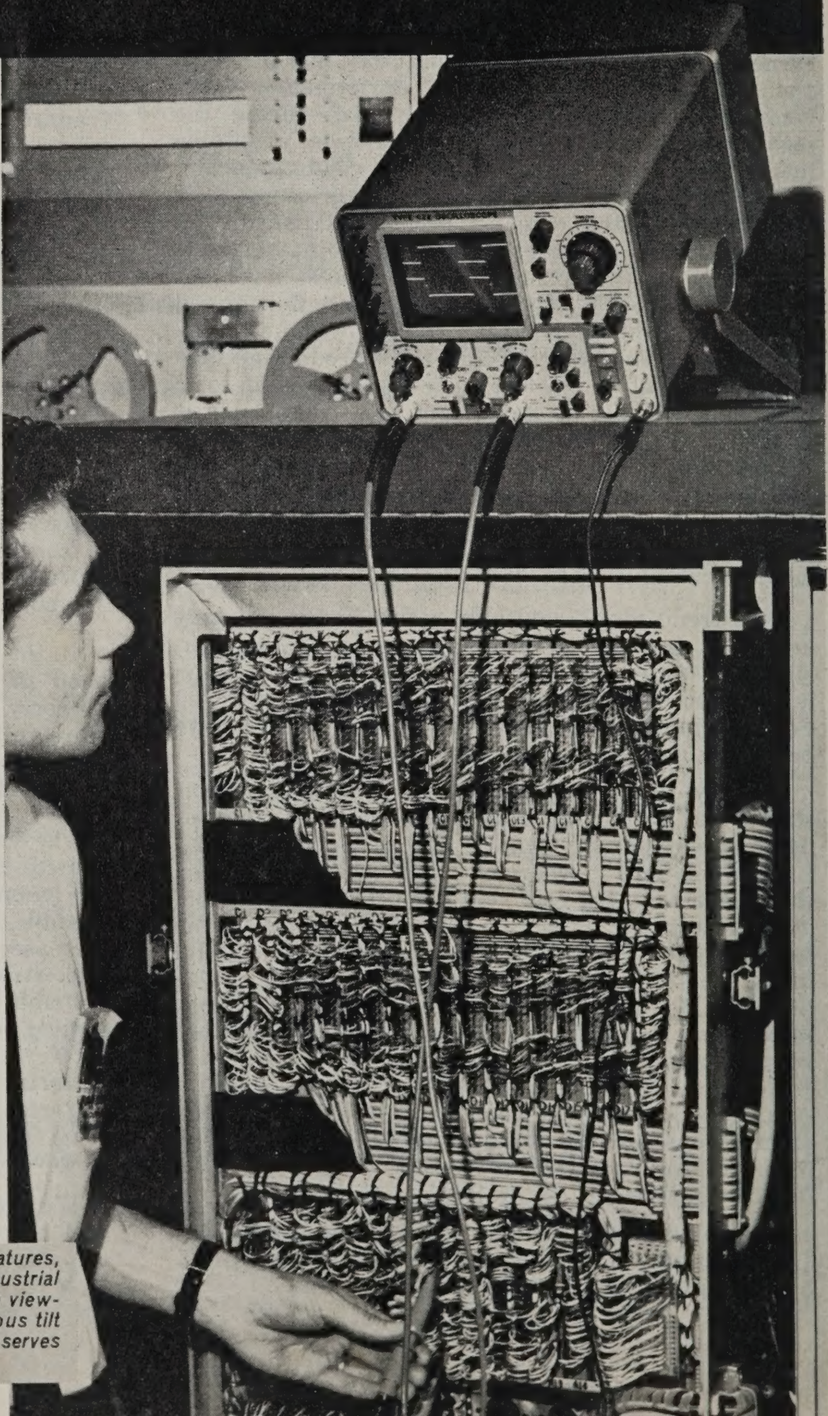

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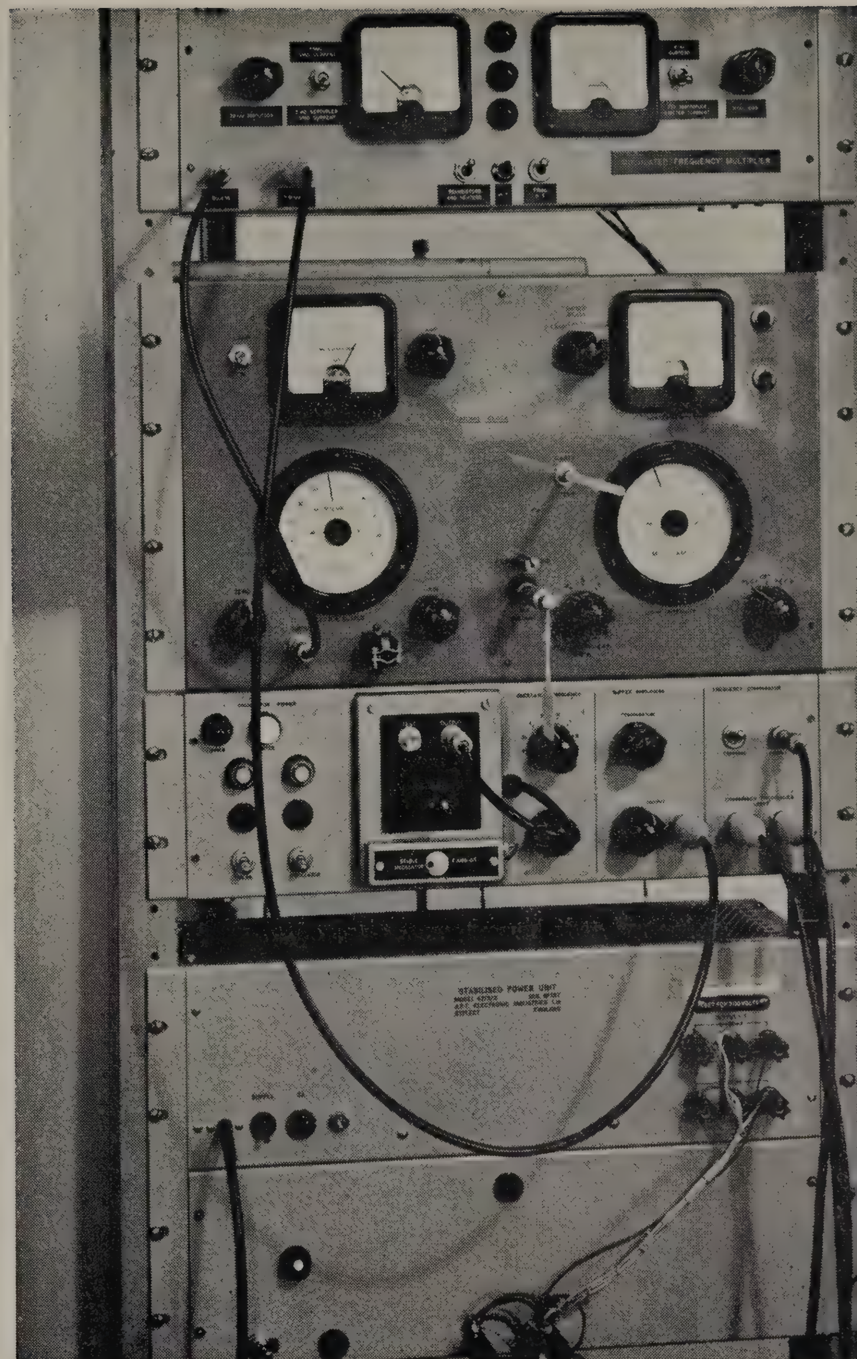
Right: New Zealand's first atomic clock; shown in diagrammatic form in Fig. 4.



Atomic Frequency Standards

by V. B. Gerard, M.Sc., F.Inst.P.
Physics & Engineering Laboratory
Lower Hutt, New Zealand

INTRODUCTION

It is well known that atoms and molecules can exist in energy states which are so closely spaced that the radiation emitted or absorbed during transitions between them falls in the radio frequency part of the spectrum. The radiation frequency, f, is given by the Bohr relationship $E_1 - E_2 = hf$ where E_1 and E_2 are the energies of two such states and h is Planck's constant.

All atomic frequency standards make use of this relationship and fall into two broad classes involving active atomic resonators on one hand and passive resonators on the other. The active devices are masers which provide a signal consisting of stimulated emission of microwave energy from the atomic particles. Ammonia masers and the recently invented atomic hydrogen maser are examples.

Passive atomic resonators are designed to stabilise conventional quartz crystal oscillators by the use of feedback control circuits which lock the quartz crystal to a sub-multiple of the atomic resonance. Ammonia microwave absorption cells, caesium atomic beams, and optical absorption gas cells making use of sodium, rubidium or caesium have all been used as passive resonators.

Historically the first device was an ammonia filled waveguide absorption cell which was tried not long after the war. However, the sharpness of resonance, or the Q, of this apparatus was limited by the kinetic molecular collisions within the cell. Such collisions constitute energy relaxation processes which limit the period of time during which any quantum mechanical particle is useful as a resonator. The perturbation-free interaction time between the atomic particle and the microwave field is the most important

single feature which determines its merit for the control of frequency.

In 1955 two groups working along different lines succeeded in demonstrating atomic frequency control of a high order.

Townes and his colleagues at Columbia University, N.Y., demonstrated maser action with beams of ammonia molecules. Although the ammonia maser has been improved considerably over the years it seems that it cannot compete with other types as a frequency standard and it is not discussed further in this article.

Caesium Beam

In 1955, also, Essen and Parry at the National Physical Laboratory, England, successfully operated the first caesium beam atomic frequency standard. Since then this type has become accepted as an absolute standard of frequency and time interval, although it is now being challenged by the hydrogen maser.

Commercial versions of the caesium beam have been marketed by at least two companies.

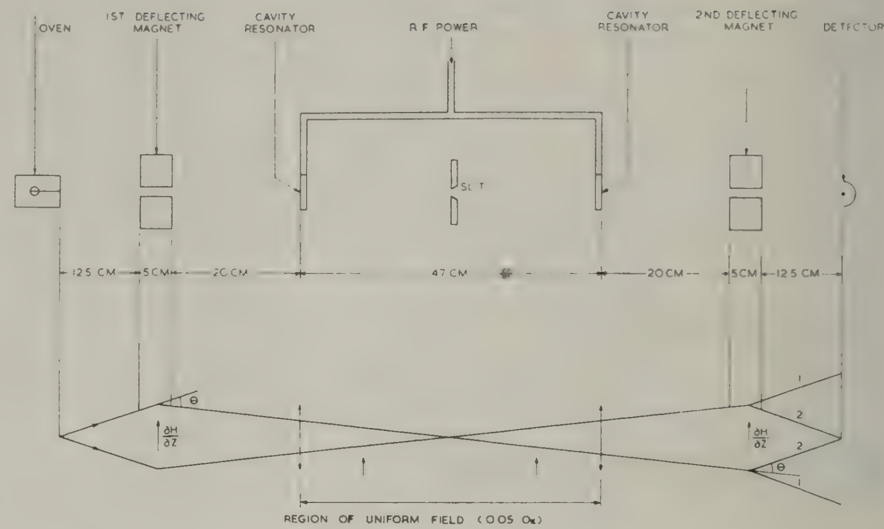


FIG 2 CAESIUM BEAM COMPONENTS

It is worthwhile examining the device in some detail, since, once it is understood, the basic principles can be applied to the understanding of the optically pumped gas cell and the hydrogen maser.

The ground state of caesium consists of two energy levels spaced by an amount corresponding to the frequency of 9192Mc/s. This splitting gives rise to the hyperfine structure of the lines in the optical spectrum. The hyperfine splitting is a consequence of the interaction between the spin of the valency electron of the atom and that of the nucleus. The spin of the electron, is ± ½ indicating that the angular momentum associated with it is ± h/2π, and that of the nucleus of caesium is 7/2. According to the direction of the electron spin therefore, there are two states designated by the quantum number F, where F = 7/2 ± ½. In the presence of a magnetic field the hyperfine levels are subject to the usual Zeeman spitting represented by an additional quantum number M_F which can have any integral value between ± F. See Fig. 1. In a weak magnetic field transitions can occur in accordance with the selection rules $\Delta F = 0, \pm 1$ and $\Delta M_F = 0, \pm 1$. The transition $\Delta F = \pm 1$, $\Delta M_F = 0$, is the one used, since this transition is nearly independent of magnetic field.

The spins impart magnetic properties to the atom, which in the presence of an external magnetic field, behaves as a magnetic dipole, the moment being positive for one state and negative for the other. In consequence of this moment the atom is deflected in a non-uniform magnetic field and the deflections are in opposite directions for atoms in the two states. This gives a means of recognising when transitions from one state to the other occur.

In the experimental arrangement, Fig. 2, atoms are emitted in a beam by collimating slots in the oven exit. There are two deflecting magnets which select atoms according to their moment. Those which undergo transitions due to the radio-frquency field are focussed on the detector.

The sharpness of the line (or Q) is determined by the time the atoms spend in the radio frequency magnetic field. Now in practice it is impossible to make this field uniform in phase and amplitude over a sufficiently large distance, but it has been shown that two short exciting regions are equivalent. Therefore two slotted cavities are used and it may be shown that the line width is given by

$$\Delta f = 0.65 \propto/L$$

where ∝ is the most probable velocity of the atoms in the beam and L is the distance between the

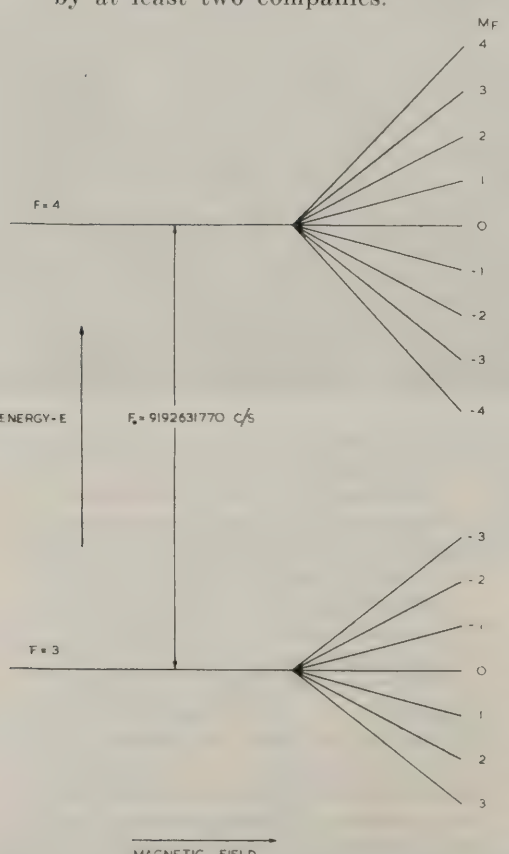


FIG I MAGNETIC ENERGY LEVELS OF CAESIUM ATOMS

cavities. In other words the line width varies inversely with the time the atoms spend in the radio frequency field.

In practice a small magnetic field is used to separate the Zeemen lines to ensure that it is in fact the 0 - 0 transition that is used. A small second order correction needs to be applied to reduce the value to zero field.

The first NPL caesium beam was 50 cm between cavities. It enabled frequencies to be determined with a precision of about 1 in 10^{10}. The second caesium beam, which has been operational since 1960, is $2\frac{1}{2}$ metres long and gives a precision and accuracy of about 1 in 10^{11}.

Variation in Length of Day

Incidentally one of the most interesting findings coming out of the NPL atomic clock results has been the variation in the length of the day, as shown by Fig. 3. It can be seen that there are three distinct variations; a large annual change, a semi-annual change and a long term trend which may turn out to be cyclic. So far as I know, none of those variations have been very satisfactorily explained yet. However, it has been estimated that the actual movement of the air, that is steady winds which vary with season, could change the angular momentum of the earth, and the length of the day by the observed amount.

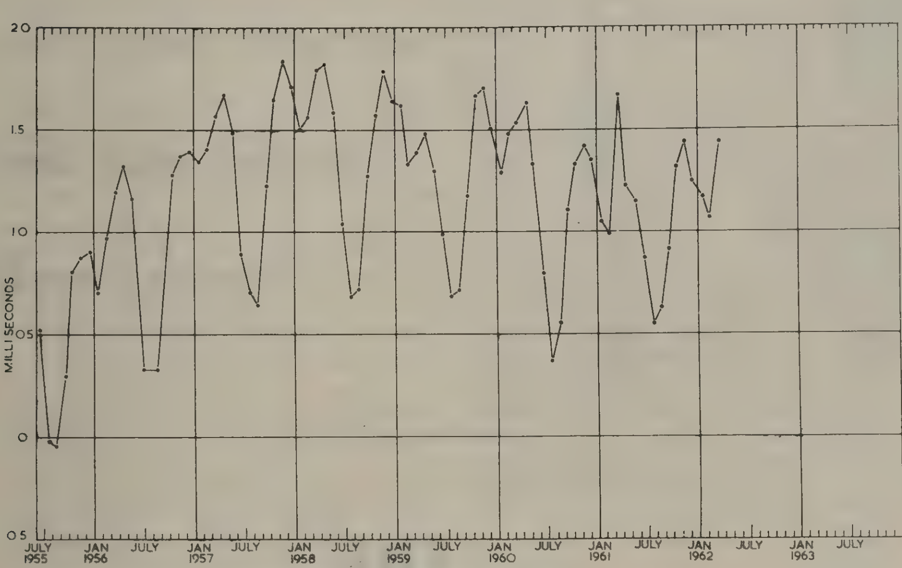


FIG 3 VARIATION IN THE LENGTH OF THE DAY AS MEASURED BY THE CAESIUM ATOMIC CLOCK

Rubidium Gas Cell

Long interaction times between microwave fields and the atomic particles may also be provided by trapping them within gases, or volumes bounded by materials which do not cause relaxation of the important energy states. In 1953 R. H. Dicke first suggested the use of buffer gases to reduce the Doppler broadening of radiation from certain magnetic dipole transitions. By the choice of buffer gases having no magnetic properties, such as noble gases, it is also possible to eliminate relaxation processes resulting from the collisions. Rubidium, and also caesium, gas cell resonators using a buffer gas, have been studied extensively for frequency control purposes, the interaction time in these devices being the period during which the active rubidium atoms diffuse through the buffer gas to the walls of the cell.

The operation of the rubidium gas cell is very similar in principle to the caesium atomic beam. However, optical resonance radiation from a rubidium lamp is used to produce a difference in population between the hyperfine levels of the ground state of Rb87 in a gas cell. This process is known as optical pumping and is now fairly widely understood for the part it plays in laser operation. When the atoms in the cell are subjected to a microwave radiation field of the correct frequency, transitions between the hyperfine levels are induced which tend to reduce the population difference built up by optical pumping and, in so doing, to change the amount of optical resonance radiation transmitted through the gas cell. This change in light intensity, which is detected by a photo cell, indicates when the applied microwave field coincides in frequency with that of the hyperfine transition. In practice the microwave frequency is frequency modulated through a range of about 100c/s, and the signal obtained from the photocell can be used to operate a serve loop to maintain the frequency of the applied field at the spectral line value. See Fig. 4. A frequency synthesiser is used to change the awkward rubidium frequency to a suitable round number, in this case it is changed to exactly 5Mc/s.

The gas cell device can be made quite small and portable. As its vacuum components can be sealed off no vacuum pumps or other bulky equipment is needed to operate it. It is therefore a pity that it is not an absolute standard as is the caesium beam. This is because the atoms in the cell are not completely free but undergo collisions with the buffer gas atoms and also with the photons of the pumping light. These collisions produce frequency shifts which depend upon the buffer gas type, its pressure and the pumping light intensity. The shift due to collisions with the buffer gas atoms is fairly well understood, but that due to collisions with the pumping light photons is not. The latter effect was first shown in 1961 by Arditi in the U.S.A. and independently, about the same time, by myself at the NPL in England. However, these drawbacks can be partly overcome, and in fact the buffer gas shift is used to simplify the synthesiser. Several firms have produced commercial versions of the rubidium gas cell standard, and there is at least one using caesium also.

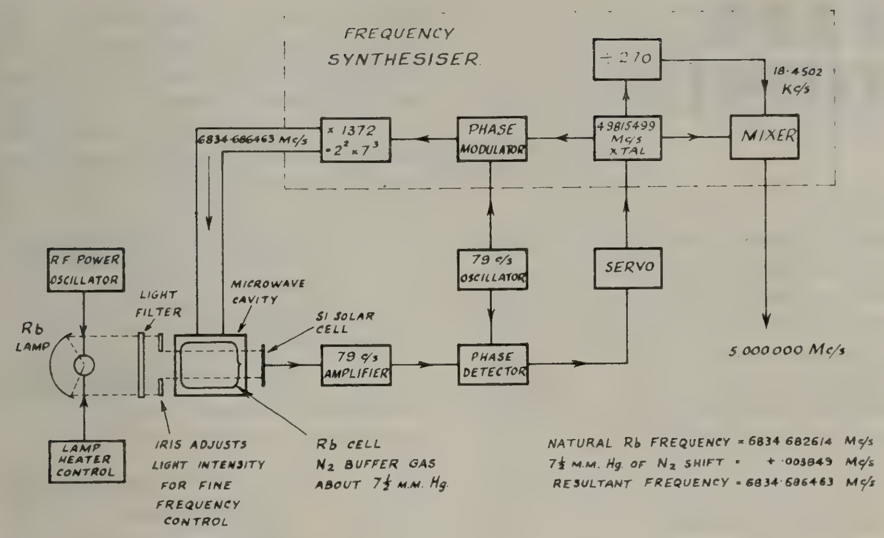


FIG. 4 GAS CELL FREQUENCY STANDARD. (ATOMIC CLOCK)

HELMHOLTZ COILS FOR CONTROL OF D.C. MAGNETIC FIELD ARE NOT SHOWN.

New Zealand's first atomic clock, shown in diagrammatic form.

Work at the Physics and Engineering Laboratory, Lower Hutt, has reached the stage where we now have a working rubidium gas cell standard which is enabling us to determine frequency at least as accurately as we can by VLF transmission from overseas atomic standards. This is about ± 1 part in 10^{10} in each case, but the VLF transmission must be integrated over 24 hours to secure this accuracy. We are at present using all natural rubidium which is a mixture of two isotopes, the desired one, Rb87, being only 27% of the total. This creates a number of problems particularly in securing efficient optical pumping. So far as I know our standard is the only one of its kind operating on natural rubidium. See Fig. 4a. All others use isotopically pure material and so obtain a higher signal to noise ratio in the detection system. However, if one is prepared to use long integration times a reasonable accuracy appears to be possible.

Hydrogen Maser

The last type of atomic frequency standard to be discussed is the atomic hydrogen maser. It too makes use of the same type of hyperfine transition, but uses atomic hydrogen instead of rubidium or caesium, and, being a maser its effective Q is much higher. Most of the work on this device has been done by Ramsey at Harvard, but Essen at the NPL is also working on it.

In 1957 Ramsey pointed out that resonance cells having walls coated with materials which produce no relaxation of the magnetic energy states during collisions would also produce extremely sharp microwave resonance free of Doppler broadening. It has been found that certain wall materials are sufficiently effective in the case of hydrogen atoms, that maser action, involving interaction times of the order of seconds, has been obtained.

Hydrogen atoms are produced from ordinary molecular hydrogen in an electric discharge and passed through a high magnetic field gradient to separate the two hyperfine states, as in the caesium beam device. The magnetic field is so shaped that atoms in the upper energy state are focussed into a beam which is directed into a quartz cell having its walls coated with a material which is highly inert with respect to hydrogen. The wall coating must be such that it does not react chemically with atomic hydrogen and magnetic wall forces must be absent in order to avoid relaxation of the hyperfine states during collisions. Materials suitable for wall coating include certain paraffins. The quartz cell is contained within a microwave cavity tuned to the hyperfine frequency, which is 1420Mc/s. Thus the cavity must be relatively large. Within the coated wall storage cell the atoms make random transits, being reflected on each encounter with the walls. If the losses are low enough coherent stimulation of the hydrogen atoms, and maser oscillation, occurs. See Fig. 5.

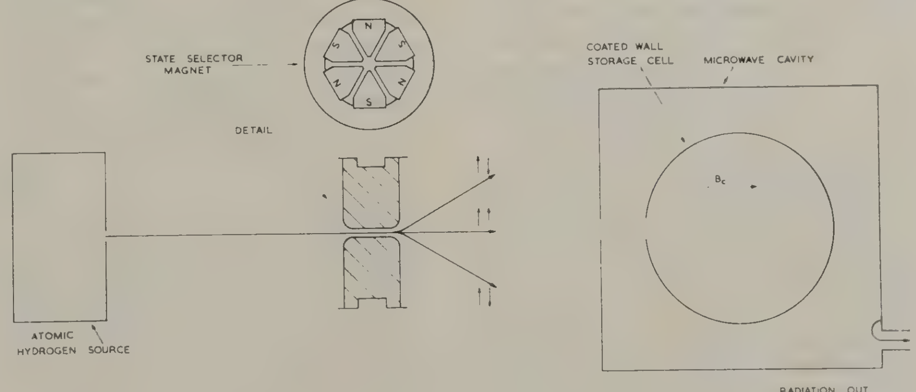


FIG. 5 THE ATOMIC HYDROGEN MASER

Because the system needs a good vacuum, but at the same time a stream of hydrogen is being sprayed into it, it must be

Continued on page 35

TAPE TOPICS

Over the past few months, a number of letters have been received, requesting information and advice on a variety of matters pertaining to tape recorders and tape recording techniques. Since these would have occupied considerable space as "Letters to the Editor," we have decided to collect all the questions and answer them together under a separate heading. At this stage, it would appear that this article could be one of several on the same basic subject. We trust that all those who have written will find some useful information in the series.
The Editors.

The first query that can be answered in a straightforward manner is "How long will my reel of "x" feet last when played at "y" inches per second." To some, apparently the problems associated with a simple calculation of this type have been greatly enlarged by the appearance of "extended play," "long play" and other varieties of tape. Irrespective of the kind of tape, the ratio of the length of tape on the spool, the speed past the heads, and the total playing time all have a fixed relationship. The only difference between the various types of tape is their thickness, and therefore the total length on a spool of a given size. For example 1½ mil. thickness tape will give 150 linear feet on a 3" spool; 600 feet on a 5" spool and 1200 feet on a 7" spool. The long play tape is usually 1 mil. thick, and there are 225 feet on a 3" spool; 900 feet on a 5" spool and 1800 feet on a 7" spool. Now double play tape is usually about 0.5 mil. thick, and 300 feet will fill a 3 inch spool; with a 5 inch spool holding 1200 feet and a 7 inch spool holding 2400 feet.

As a guide Table I shows the times listed to the nearest whole minute for one track or set of tracks running in one direction.

The next most common queries relate to tape recording heads, their demagnetisation and alignment. Recording heads tend to pick up a certain amount of residual magnetism when very strong signals are applied, causing the amplifier to overload and produce squaring or clipping of the signal waveform. Heads also can be magnetised if magnetised tools, torches or other appliances are left too near to decks. When a head becomes magnetised, whatever the cause, it will not give good results.

Readers should note that while particular reference is made here to the composite record-playback head used in many tape-decks, the remarks apply equally to individual record, replay—and to a lesser extent—erase heads also. Main effects produced by a magnetised head are increased distortion, increased noise level, and loss of high frequencies, which are in fact partially erased by the permanent magnetic bias.

We recommend that demagnetisation and alignment of the heads is best carried out by a qualified and well equipped service centre or agent for the particular model of tape unit. However, some readers will prefer to do the job themselves, and some will have makes of decks with no known service agent. This appears to be the case for quite a few of the more recent arrivals from Europe and Asia. If a service manual is supplied with the recorder, the procedure outlined therein should be followed.

In some cases it is possible to satisfactorily demagnetise the heads using the field from a mains-powered bulk erase unit. These are available from most commercial tape supply houses and service centres. The tape erase unit is energised, and held close to the pole surfaces of the head. The head is moved back and forth so that the field from the demagnetising unit moves across all parts of the face of the head, which is then removed slowly to a point several feet away from the erase unit before the power is switched off.

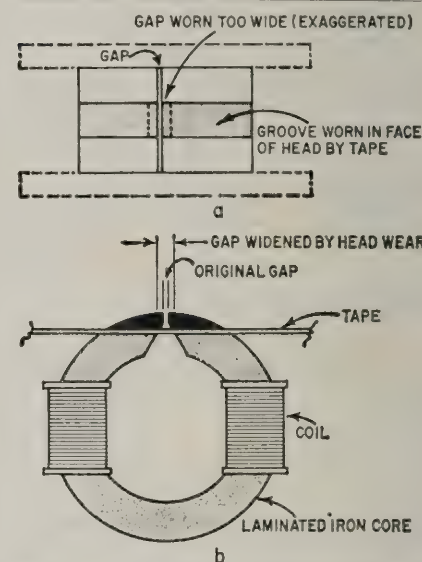


Fig. 1 — Diagram showing the effects of tape wear on face of head.

Before touching on the subject of head alignment, a little should be said about wear of the heads.

The pole pieces of record-playback and erase heads are made of relatively soft materials, chosen mainly for their good magnetic characteristics. Many modern

Table I

Feet on Reel	Tape Speed — Inches per second $1\frac{7}{8}$"	$3\frac{3}{4}$"	$7\frac{1}{2}$"	15"
150	16 minutes	8	4	2
225	24	12	6	3
300	32	16	8	4
600	64	32	16	8
900	96	48	24	12
1200	128	64	32	16
1500	160	80	40	20
1800	192	96	48	24
2000	213	106	53	27
2400	256	128	64	32
3000	320	160	80	40
3600	384	192	96	48

heads are then given a smooth plastic coating to keep wear to the minimum. While modern tapes are not as abrasive as some of the earlier kinds, there is always some slight abrasive action which wears down the surface of the head. It is therefore wise to keep the deck and head surfaces clean and dust free. Tapes should be stored in such a clean area.

Wear on a head can be checked easily when it is removed for demagnetisation. In good condition, the face of a recording head will be smooth and shiny, whereas a worn head will show a distinct groove, the width of the tape (see Fig. 1). In many cases this wear causes an increase in the width of the gap in the head across which the tape passes during transport. This will cause a reduction in high frequency response both while recording and also on playback.

Cleaning the Heads

As the tape passes the heads, small particles of dust and tiny particles of oxide are scraped off the tape, adhering to the head's surface. This interferes with the close contact between the tape and pole pieces of the head and after a period of time, if the heads are not cleaned, it is possible that there will be a loss of volume and /or treble response.

Carbon tetrachloride and other similar fluids are NOT recommended as general cleaning fluids unless specified by the deck manufacturer. They could damage plastic surrounding the heads. Methlated spirits, in small quantities, applied with a cotton swab stick is probably the safest cleaning agent. Ensure that all cleaning fluid has evaporated before threading a tape or the fluid may affect the tape.

The Alignment of the Heads

Alignment of the heads with the tape is very important, especially in the case of four-track stereo decks. In this case there are four tracks, recorded two at a time in an interleaved fashion, on a single tape.

For best results, head and tape guides must be orientated so the tape travels squarely across the gap in the pole pieces of the head. If this is not true, then the tape will not be correctly recorded, it will not play back correctly on another deck, and will probably not sound satisfactory even when replayed on the deck on which it was recorded.

If the tape is inclined to the axis of the head then there is loss of high frequency signals, possible partial erasure of one track in a multi-track system, and serious balance disturbance on a stereo system. These last two effects can also be produced on correctly recorded, pre-recorded tapes if the playback head is not set at the correct height in respect to the tape guides.

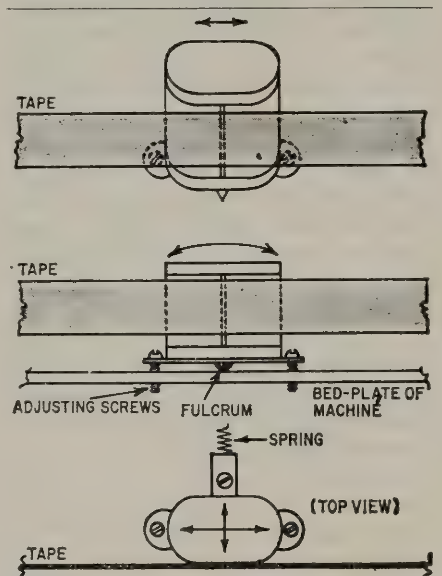


Fig. 2 — Diagram showing with arrows the directions for typical adjustment of azimuth.

Testing for Correct Head Alignment

Testing for head alignment is generally fairly simple. Two basic methods can be used. The first involves direct measurement from known reference points. This can be accomplished if data is available from the service manual for the particular deck. The second method used, and possibly the easier method, involves setting the heads by approximate measurement and then carrying out final adjustments with a pre-recorded test tape.

Unless head height has been altered, the only adjustment usually required are for correct azimuth, this is making certain the gap in the face of the head lies at right angles to the central axes of the tape.

Azimuth Adjustment

For correct azimuth it is necessary to adjust the record-playback head for maximum treble response. A tape, pre-recorded and with a prolonged high frequency tone should be used. The tone frequency should be selected for the appropriate tape speed, for example 5000 to 7500 c/s for $3\frac{3}{4}$ inches/sec.; 7500 to 10,000 c/s for $7\frac{1}{2}$ inches/sec.; and about 15,000 cs for 15 inches/sec. An audio frequency voltmeter with level response at the test frequency should be connected across the speaker output line or extension speaker outlet, with the level kept well below overload point. Head adjusting screws should now be altered to tilt the head slightly right or left until maximum output is indicated on the meter (see Fig. 2).

Beware of "false peaks" which may occur on either side of the much larger true peak. With a stereo system, the azimuth alignment should be checked on both channels of a stereo head. In some cases the two gaps are not exactly in line, and optimum alignment cannot be achieved simultaneously on both channels. It is then necessary to effect a compromise alignment which results in about the same treble loss in both channels.

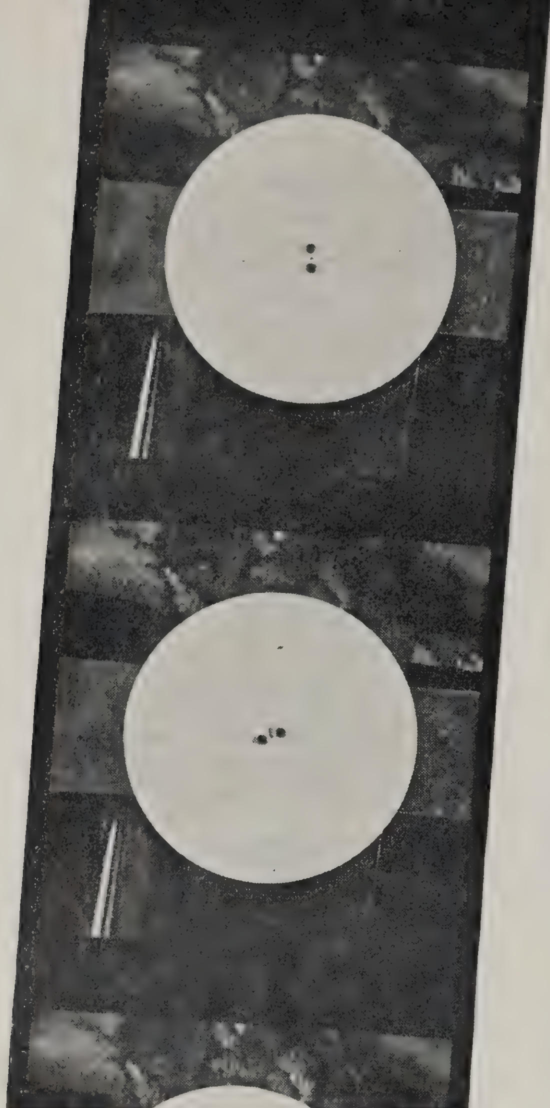
If the recorded has separate record and playback heads, the playback head is aligned first on a pre-recorded tape. The record head is then aligned for maximum output from the playback system while recording a tone into a tape passing through the system.

Head Alignment in the Vertical Direction

The gaps on the record and playback (or record-playback) and erase heads must span the same portion of the tape. Improper vertical positioning causes loss of signal, crosstalk, particularly in the case of four track stereo heads, and incomplete erasure.

For mono and half track stereo heads, vertical alignment can be performed with a pre-recorded test tape bearing a low frequency tone, in the vicinity of 400 c/s. So that moderate changes in azimuth as the head is moved do not significantly affect signal output. If

Continued on page 33

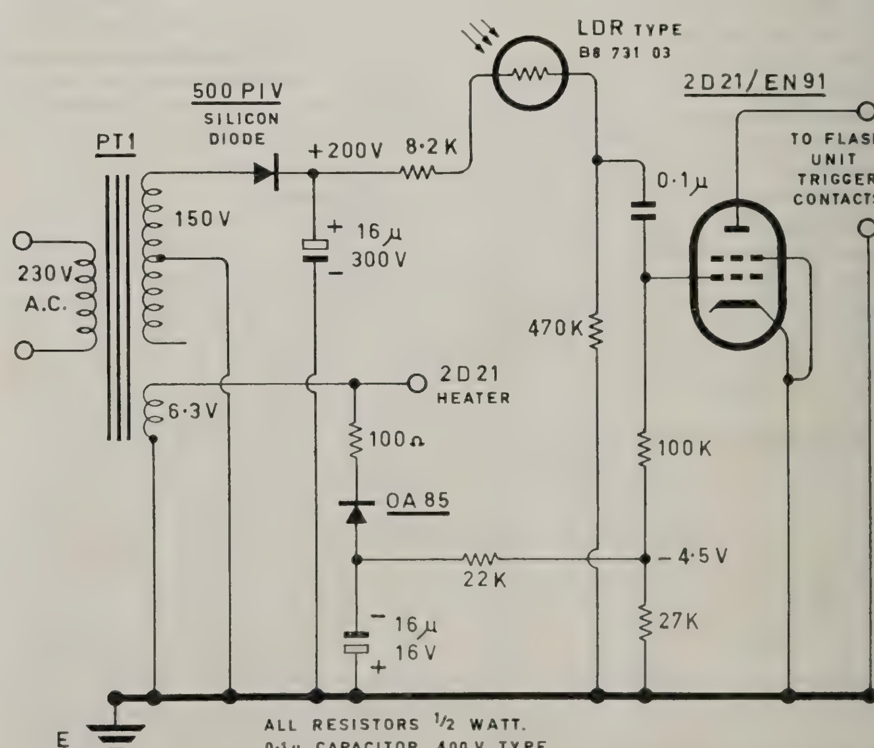


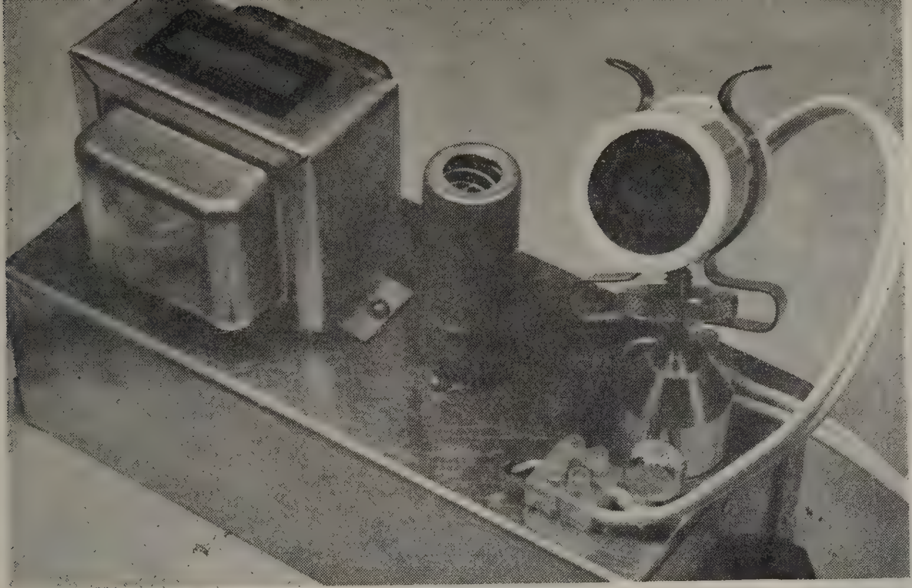
Most photographers at some time or another require a second or perhaps a third light source to achieve a particular lighting effect. Where incandescent light sources are in use the solution is obvious. Where electronic flash is the source of lighting, it is possible to use a second or a third flash if available. However, certain problems arise. If all the electronic flash units are identical, the firing control circuits should be capable of all being connected in parallel to the flash contacts of the camera. If non-identical flash units are used which will often be the case, this course may not be possible. Circuit differences may preclude the simple paralleling of trigger circuits of different types of flash units. Even with identical units the simple paralleling of firing circuits is undesirable from the point of view of the camera. Additional current loading of the camera flash contacts may cause them to become erratic as a result of burning and arcing. Definitely not the sort of treatment for any camera. Some form of slave unit triggered by the pulse of light from the main flash and arranged to fire the extra flash unit or units would appear to be a good solution. More than one such slave unit could be used for special effects. A further benefit from the use of a light triggered slave is the freedom from wires connecting the photographer to the additional flash units.

The common type of electronic flash unit is triggered by a charged capacitor, usually of the order of 0.1 microfarads, being discharged through the primary of a pulse transformer. The closing of the camera flash contacts as the shutter operates, completes the circuit. Since the primary impedance of the pulse transformer is low and the capacitor may be charged to several hundred volts, quite high peak currents can flow. Hence the need for caution in adding to the current flowing through the camera flash contacts. Now considering the problem of a slave trigger unit, the camera contacts will have to be replaced by some other circuit completing device. A relay is a possible solution but perhaps a little slow for high shutter speeds. A thyratron seems the answer with the tube being triggered by some sort of photosensitive device. Gas or vacuum photo-cells could be used but they

Electronic Flash Slave Unit

By H. BURTON





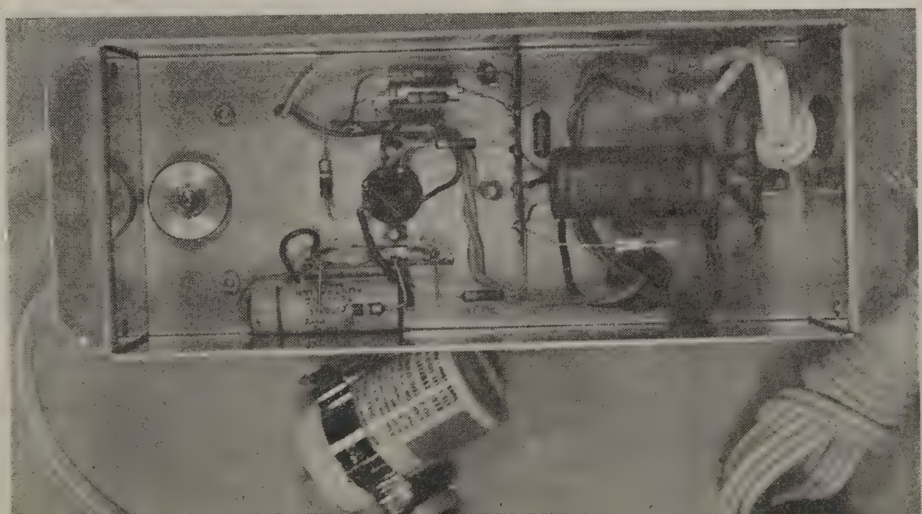
cause triggering. It is a change of incident light in the increasing direction that causes triggering and hence the system is reasonably tolerant of ambient light conditions. However to prevent saturation of the LDR it is advisable to mount it in a hood. A plastic hood is suggested for safety since the LDR is at an elevated potential relative to the chassis. The photo of the unit shows a plastic tablet container mounted on a ball and socket head, the LDR being at one end of the container looking out through an aperture at the other end. A simple double convex lens is mounted at the opposite end of the hood to the LDR but this is not essential.

The power supply uses a small instrument power transformer to supply 6.3 volts for the thyratron heater, —4.5 volts to hold the thyratron cut off, and +200 volts for the LDR supply. Semiconductor rectifiers are used. Construction and layout are non-critical. The chassis size is 7 x 3 x 2 inches.

When connecting the slave trigger unit to the slave flash the polarity of the trigger unit of the latter must be checked to ensure that the positive terminal is connected to the anode of the 2D21/EN91. It is suggested that once the correct connections are established a polarized plug be used. Similar input sockets on different flash units have been found to have differing polarities, so beware. With the circuit as shown the voltage rating of the LDR (110V peak) is exceeded, and if it is desired to stay within the published ratings, the LDR supply voltage could be reduced to 100V by a potential divider connected across the filter capacitor.

are expensive and fragile. Photo transistors also are rather on the expensive side, and these days it is not possible to doctor an OC71 by scraping the paint off the outside as the manufacturers have put an opaque coating on the inside of the glass envelope. There is available a simple, robust and cheap device known as a light dependent resistor or LDR. These devices are used in some television receivers for automatic contrast and/or brightness control under changing ambient light conditions. They are commonly regarded as rather slow acting devices and may not seem suitable for the purpose suggested. They are, however quite satisfactory. Use is made of the sharp drop in resistance of an LDR upon receipt of a pulse of light from the master flash to provide a rapid positive change of potential at the control grid of a thyratron. The latter thereupon fires and completes a path to discharge the capacitor in the flash trigger circuit. To evaluate the speed of response of the LDR the following experiment was set up. A slave unit was built as shown in the circuit. A white cardboard disc 5'' in diameter was attached to the ends of the shaft of an electric motor. A single radial line was drawn on the disc which was then rotated at 1400 R.P.M. by the motor. A camera was set up to photograph the spinning disc at a low shutter speed, and two flash units were arranged to provide the only illumination. The master flash was triggered by the camera flash contacts, and the slave flash was triggered via the slave unit from the pulse of light generated by the main flash. If there was any significant delay in the firing of the slave flash, two radial lines should have appeared in the photo as a result of separate exposures of the same line in two different positions. Only one line can be seen in the photo. However two shadows cast by the heads of the fixing bolts holding the disc on to the motor shaft can be seen, thus showing that both flashes did operate while the shutter was open. Some blurring of the radial line is evident towards the edge of the disc but this is to be expected. The nominal length of the flash of most electronic units is of the order of one millisecond. In one millisecond a point on the edge of a disc rotating at 1400 R.P.M. will move approximately one third of an inch which is consistent with the blurring observed. We can conclude from this that the flashes occur almost simultaneously and that the delay is insignificant.

Sensitivity of the unit is quite adequate. Bounced flash may be used with reliable triggering, and even the light of a dim torch quite a number of feet distant when moved across the field of view of the LDR is sufficient to

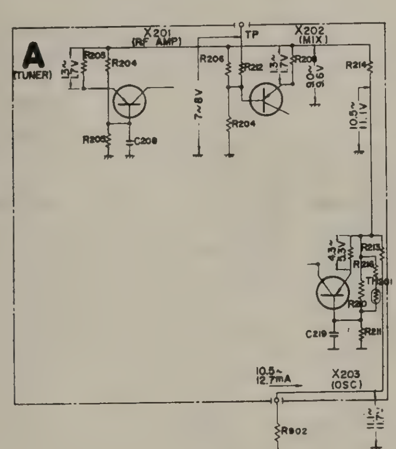


Circuit and Service Data

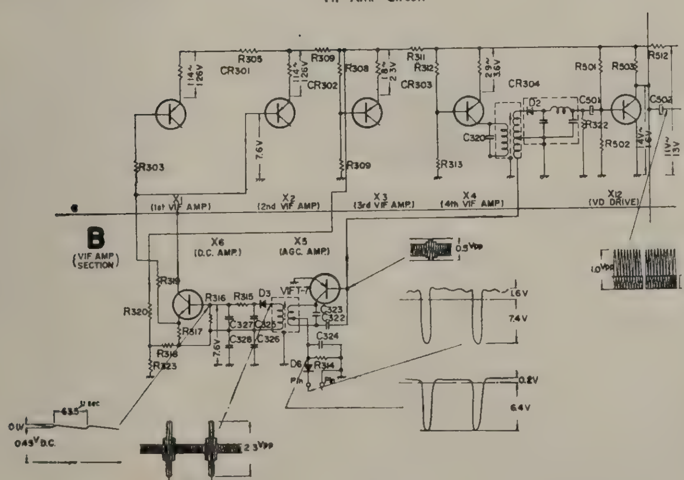
SONY
5" Tv. Receiver –Tv.5-303A

Our circuit feature this month is a departure from normal treatment. We present information on a set not currently a New Zealand production model. However through a variety of sources there are many on the local scene and some undoubtedly in need of servicing. In the SONY Manual the normal technique described is to locate the fault and replace the complete section or block. This obviously is not practical in N.Z. — hence we have shown circuits of the individual sections including voltage readings. This provides readers with basic information for repairing individual faults. Inevitably much patience and logical servicing technique will be necessary. The main circuit appears on page 22.

— Tuner —



— VIF AMP Circuit —



METHOD OF DISASSEMBLING THE SET

To Remove the Front Control Panel:—

1. Pull all control knobs straight out. The fine tuning knob may be somewhat difficult to remove — use force.
2. Remove the two small screws on the front control panel. The front control panel can now be removed.

To Remove the Back Cabinet Cover:—

Remove screws located on the top and on the left side. Remove four screws at the back. The back cover can now be removed by pulling straight back.

To Remove the Telescopic Antenna and the Tuner:—

1. Pull off the pin connectors of the tuner I.F. lead wire and the shielded ground wire from the terminals on the signal circuit board.
2. Remove the screws on top, rear and back of the tuner.
3. Push the telescopic antenna and the external antenna connectors towards the rear. The telescopic antenna and the connectors can now be detached.
4. The tuner can be detached by removing two screws on the front located near the tuning control shaft. One screw is on the front panel, and the other is inside on the tuner. The tuner, telescopic antenna and antenna connectors can be removed from the set by unsoldering the red wire to the front of the tuner, the black wire to the chassis and the yellow wire with the resistor to the antenna jack. The I.F. lead-wire to the tuner with the pin connectors can be pulled through from the back of the picture tube.

To Remove the Signal Circuit Board:—

Remove screws at Front corners. Slightly loosen the screw holding the connector socket on the back of the chassis. Pull out the two connectors from the pins on the back side of the signal circuit board. The block can be removed as a unit by pulling directly away from the connector socket.

To Remove the Deflection Circuit Board:—

1. Remove 3 screws along the top front edge of the chassis.
2. Pull out the green and yellow connectors on leads to the deflection yoke.
3. Pull out the red, black, blue and white connectors, all located together, and the yellow connector on the lead to the picture tube.

To Remove the Chassis from the Front Panel:—

1. Remove screws on top, side and bottom flanges of front panel.
2. Remove the screw from the front adjacent to the tuner cut out, after pulling off the channel selection knob and the fine tuning knob.
3. Unsolder the red, blue, and black wires from the pin connectors. These wires go to the picture tube yoke. Also unsolder the green wire from the choke coil located just below the speaker. Pull off the high voltage anode connector from the side of the picture tube. This is a snap fastener but use caution in removing it. Pull off the socket of the picture tube straight back.

To Remove the Picture Tube:—

Remove the screws and nuts at top and bottom of picture tube face and lift up the picture tube.

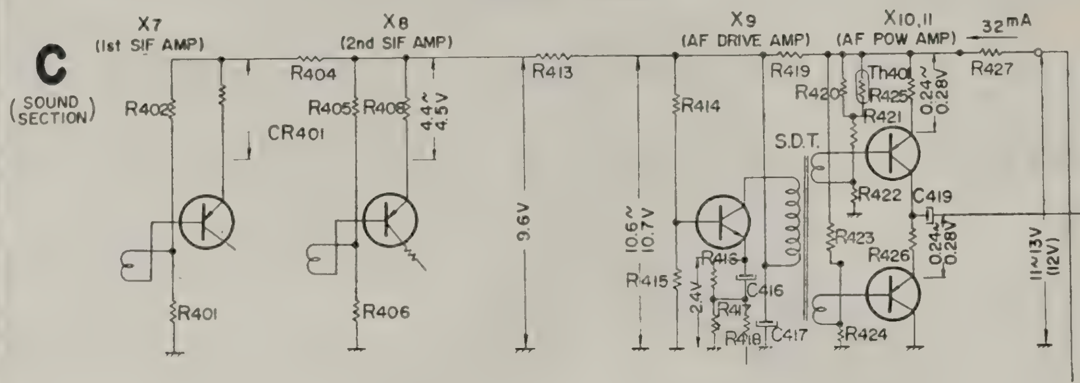
To Remove the High Voltage Block:—

1. Unsolder the red, blue and black lead wires.
2. Pull off the anode cap.
3. Pull off the pulse supplying pin connectors from the signal circuit board.
4. Remove the Phillips head screw.

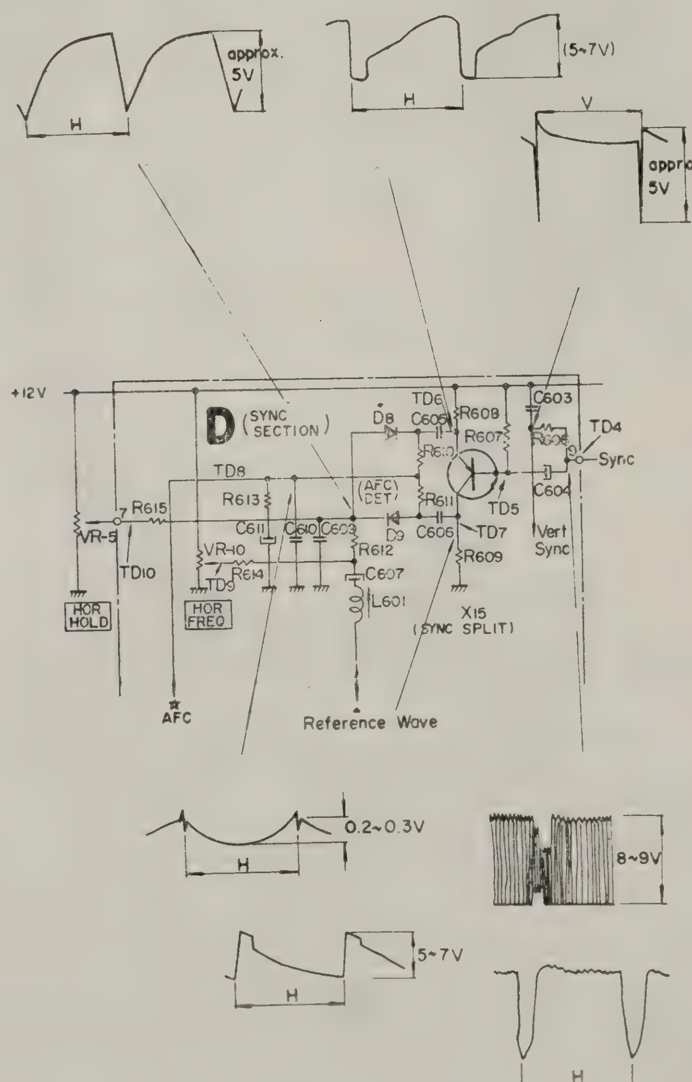
Note:—It is not recommended that the high voltage block be disassembled because a special insulating material is used to coat all high voltage points.

NOTE: When troubleshooting NEVER ATTEMPT TO CHECK THE HIGH VOLTAGE (8 kV) CIRCUIT BY SPARK TEST as this is likely to cause damage not only to the Horizontal Deflection Currents but will also adversely affect the transistors on the Signal Circuit Board because of the Pulse A.G.C. circuit employed.

— SOUND Circuit —



— SYNC SPLIT Circuit —



DC Voltage : TD_4...10V, TD_5...11.5V, TD_6...10.5V, TD_7...1.5V
TD_8...5V, TD_9...6.5V, TD_{10}...5.5V

SPECIF

Picture Tube:

Transistor:

Diode:

Channel Coverage:

Maximum Sensitivity:

IF Circuit:

Resolution:

Sound System:

Automatic Control:

Power Requirement:

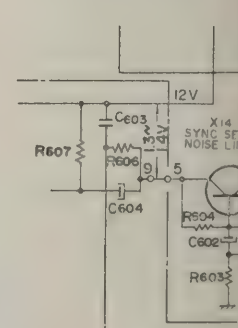
Power Consumption:

Dimensions:

Weight:

Glare Proofing:

— SYNC SEP, AMP & NOISE LIMIT Ci



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E-11

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26.75 Mc, Sound
Mc, Bandwidth
-3 dB to -6 dB

400 lines, Horizon-
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ntercarrier System
Output Stage OTL
50 mW. Speaker
Voice Coil

erated AGC, Diode
c. ANS (Automatic
ppressor)

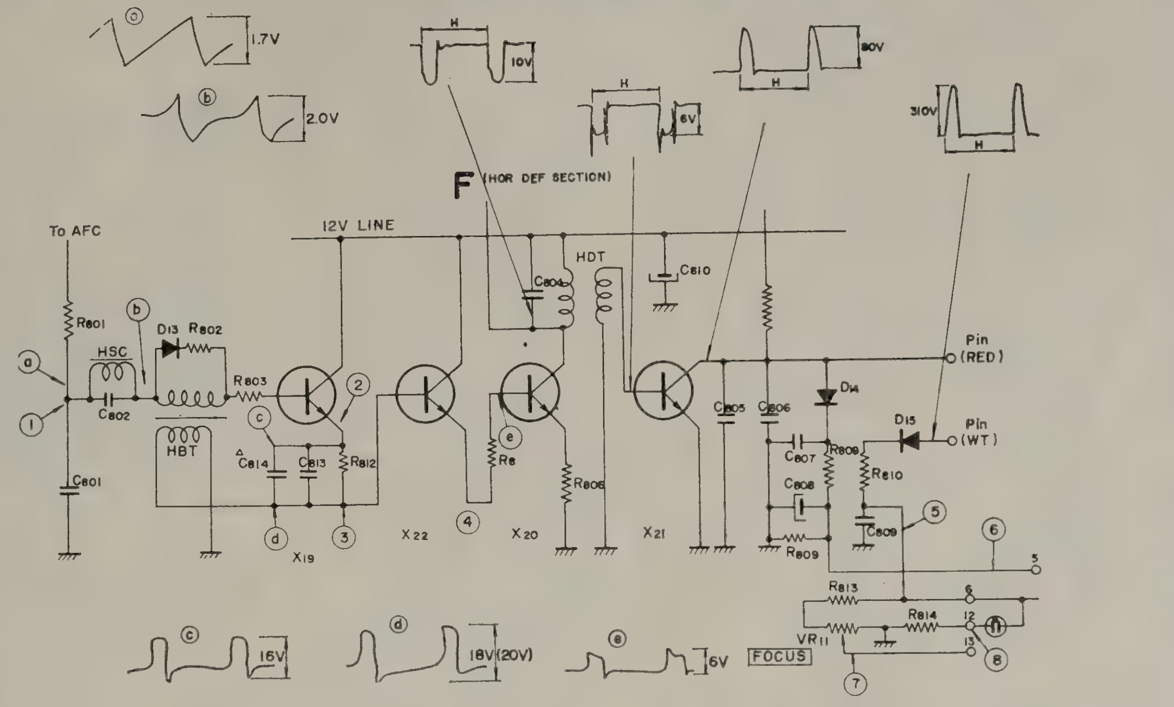
V, 50c½s, DC 12V
3.5 AH)

DC 9.6W (0.8A)

4¼" (H) 7¼" (D)

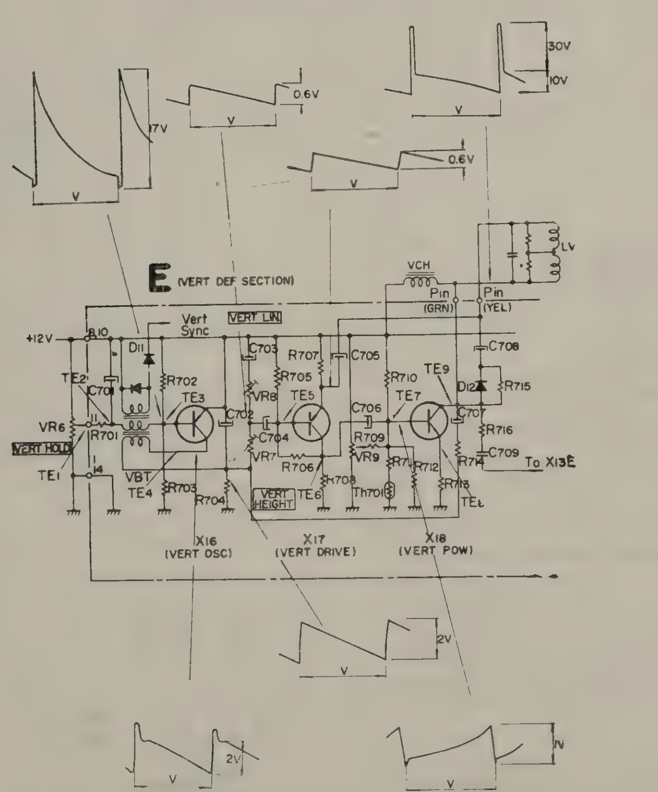
Filter, 70% Trans-

— HOR DEF Circuit —



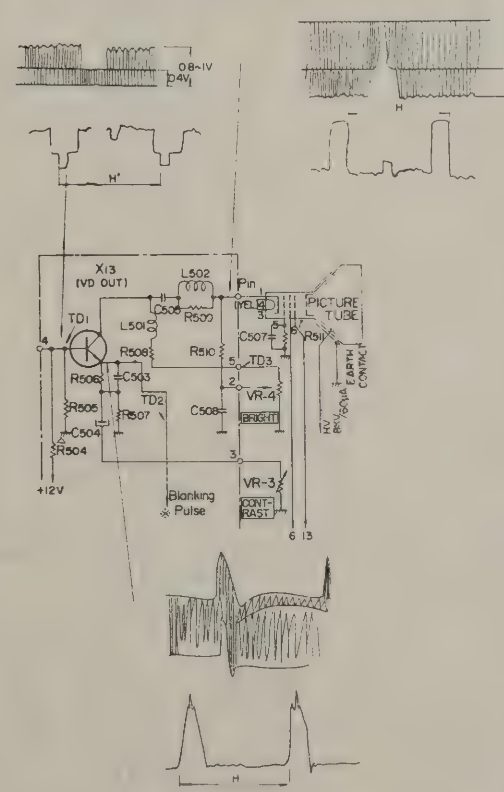
DC Voltage: ①...2.1V, ②...2.7V, ③...0.02V, ④...1.7V
⑤...290V, ⑥...50V, ⑦...50~100V, ⑧...230V

— VERT Deflection Circuit —

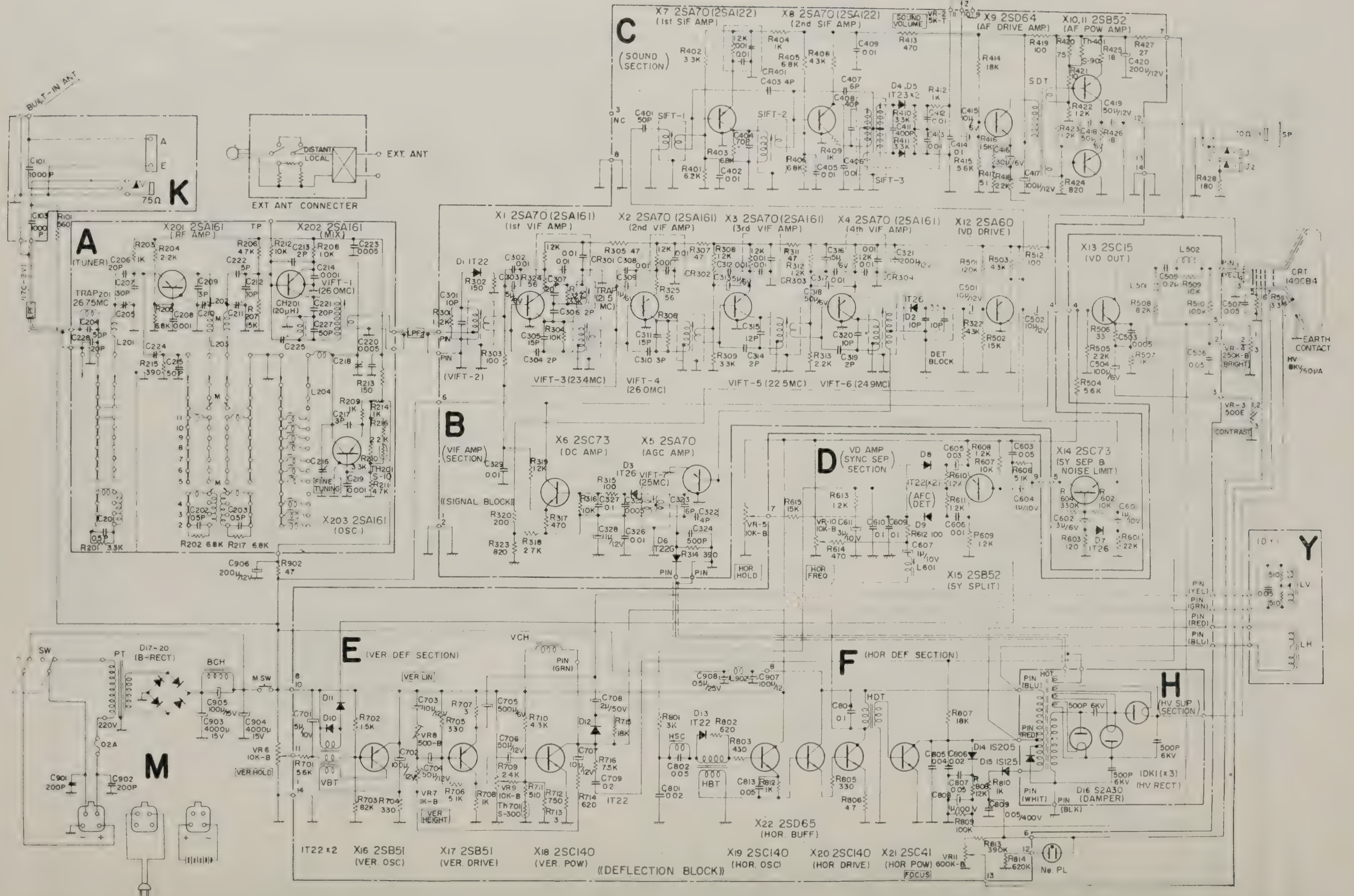


DC Voltage: TE_1...6~9V, TE_2...16V, TE_3...16V, TE_4...5.5V, TE_5...11.7V, TE_6...8.0V, TE_7...1.0V, TE_8...0.33V, TE_9...9.5V

— VIDEO Output Circuit —



DC Voltage: TD_1...3.2V, TD_2...2.6V, TD_3...50V



△ To be adjusted and value may differ from that indicated.

※ Used in some set for adjustment purpose.

SERVICEMAN'S COLUMN

Conducted by J. Whitley Stokes

Sometimes I receive communications from various people offering suggestions for comment in this column. Although, as its title suggests, the column is supposed to be concerned with the various aspects of servicing, there have been times when comment may have strayed a little beyond these confines. However as I have not yet been castigated by the editor, I can only assume that at least there have been no unfavourable remarks from readers.

One such suggestion received a while ago, was quote:— "Maybe you can educate some of your colleagues some time in such things as, why do you need a series resistor about 4·7 to 6·8 ohms or similar with silicon diodes and why a dropper on the other end? Seems like some servicemen should go back to school. The ignorance of a large number of them is legend," unquote.

Hands up all those who know the answer! Quite frankly I'm confused about this "dropper on the other end" though. A surge limiting resistor is incorporated as a matter of course by the designer so that the serviceman can only be concerned by the possible failure and subsequent replacement of this item.

Next suggestion.

Why don't I comment on the many poorly erected TV aerials to be seen everywhere? Well perhaps I should, not that any comments of mine are likely to have any effect on the situation. To my way of thinking this state of affairs is the result of probably 95% of TV aerials being erected by unregistered tradesmen in fact not any sort of tradesmen. This, coupled with the fact that the majority of aerials are erected on a contract basis, has led to far too many jobs being done in a very sloppy manner.

In fairness to the more responsible firms I must say I think most of the very rough jobs can be attributed to some of the small one and two man installation "companies" operating on a fly by night basis. However, as I told my complainant, if we had to rely on registered men to do all the installations there just wouldn't be any installations or at least mighty few and that is the crux of the matter.

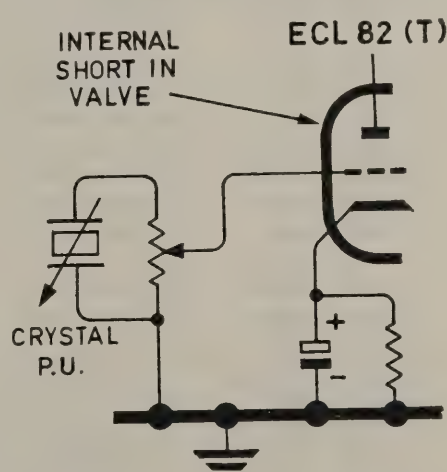
As yet it is a bit early to have been able to get many comments on the recently announced extended guarantee on components of TV receivers. At the time of writing two firms have announced their intentions of increasing this guarantee from the present 90 days to 12 months. All I can say is that if it is possible to do this now without any significant increase in reliability, then it would have been possible to do so earlier, at least at the time of the introduction of the 12 month's guarantee on picture tubes.

As usual the burden of the guarantee will fall most heavily on the dealer, for labour costs must still be met by him. One would imagine that the country dealer with 20 or 30 mile, even 40 or 50 mile, service calls would be least happy at this extension of guarantee, yet strangely it appears that some country dealers have been "beating the gun" by offering longer guarantees on their own bat.

Frankly I am as much interested in the motives behind such a move. I am also interested in the anomalous situation which now exists whereby radios and radiograms which can and do run for five years and longer without any need for servicing, are still only guaranteed for a period of 90 days. No, I am afraid the new TV guarantees cannot be taken as a gesture of confidence from the manufacturers, indicative of increased reliability in their products, rather it is a move to counter the feared effect on sales of the "built-in" service contracts being offered by some rival firms.

The following description of an unusual fault is submitted by PHR (Wellington).

One of my colleagues had a record player brought to him for service. It was one of the more common ones using a triode/pentode as the complete amplifier. The valve was an ECL82 actually.



The customer was not very helpful either, merely suggesting that "It doesn't go". In a simple piece of equipment such as this there is not much that can go wrong and on that basis the player was plugged in and the volume turned on full. This in case the cartridge might be weak or a broken crystal or some similar fault. Imagine my colleague's surprise when, upon the valve heating up, the crystal cartridge started to smoke. Yes that's right smoke. "Never" you will say. "Couldn't happen". Well it did. The player was of course promptly switched off and a more thorough examination was called for. Whoever heard of a cartridge smoking? A quick check with the meter soon revealed the trouble. It revealed a short in the triode section from grid to plate. From the circuit it is apparent that the fact of the volume control being on full accelerated the fault. Replacing the ECL82 and of course a rather fried cartridge cured the trouble. Just goes to show — You thought you'd seen everything — now you have.

I enjoy your column and hope this small contribution might bring forth some further strange faults.

—PHR.

I suppose the reason why such occurrences are not more common is that most record players or radiograms employ grid leak biasing of the first audio stage and thus the pickup cartridge is isolated by the coupling condenser.

LISTENING POST

by michael lawrence

All frequencies are given in kilocycles and times in GMT.

Continuing last month's list of shortwave stations which may currently be heard in N.Z., we now list those stations from 11Mc/s to 21Mc/s.

Freq.	Station	Time
11710	Melbourne	0515 - 0615
		0645 - 0915
11740	Vatican	2130 - 2300
11750	BBC Singapore	1100 - 1200
11780	Wellington	2000 - 0545
11795	Deutsche Welle	0645 - 0945
11820	BBC London	2000 - 2245
11825	Taipei	1130 - 1330
11825	Papeete	0300 - 0730
		1615 - 1715
		2030 - 2300
11840	Warsaw	0700 - 0900
11840	Melbourne	1800 - 2115
11850	Norway	0745 - 0815
		1900 - 2000
11855	Manila	0900 - 1030
11865	Switzerland	2100 - 2230
11875	Tokyo	0930 - 1030
11880	VOA Dixon	1600 - 1630
11905	Rome	2030 - 2115
11915	Quito	0700 - 0930
11925	Deutsche Welle	0845 - 0945
11955	BBC London	0600 - 0845
15060	Peking	0830 - 0900
15110	Wellington	2245 - 0545
15165	Delhi	1000 - 1100
15165	Denmark	0630 - 0700
15175	Norway	0745 - 0815
15180	Melbourne	0515 - 0615
15185	USSR	1000 - 1530
15205	Deutsche Welle	0645 - 0945
15230	Melbourne	2230 - 0800
15235	Tokyo	0930 - 1030
15240	Melbourne	0030 - 0645
15265	USSR	1400 - 1530
15275	Deutsche Welle	0845 - 0945
15290	Delhi	0700 - 0800
15305	Kiev	1330 - 1600
15400	Rome	1200 - 1230
15425	Holland	1400 - 1445
15425	Perth	0000 - 1030
15435	BBC London	0600 - 0800
		0915 - 1130
17705	Delhi	0700 - 0800
17735	VOA Dixon	2200 - 2230
17745	USSR	0800 - 1500
		1600 - 1630
17810	Manila	2200 - 0030
17835	Peking	0845 - 0930
17845	Deutsche Welle	0845 - 0945
17845	Sweden	1230 - 1345
17850	VOA Dixon	0130 - 0230
17870	USSR	0800 - 0930
17895	USSR	0700 - 1230
21540	Melbourne	0100 - 0800

The above times do not necessarily indicate the whole transmission period of that particular station but, are merely the times during which that station was observed. In some cases, such factors as increased interference or reduced signal strength made the rest of the transmission inaudible.

CRICKET BROADCASTS

During the current tour of England by the N.Z. cricket team, the BBC is broadcasting ball-by-ball commentaries of the test matches in special transmissions beamed to N.Z. The third test starts on July 8.

Details of the broadcasts from U.K. transmitters are: 0945-1545 on 21,710; 0945-1745 on 17,695; and 1545-1745 on 15,105.

Relay facilities at Cyprus are used from 0945-1330 on 21,660 and from Singapore 0945-1245 on 11,750; 1200-1745 on 9,765; and 1330-1745 on 7,260.

Commentaries of other major matches against Surrey, Somerset and Northamptonshire starting on June 9th, June 12th and July 3rd respectively, are broadcast in the BBC World Service on 12,095 and 15,070 at the following times: 1200 - 1235; 1430-1500 and 1700-1735.

STATION NEWS

ISRAEL. The Voice of Israel at Jerusalem now broadcasts to Africa one hour later than previously. The French broadcast is from 2015 to 2045 and English from 2045-2115. Frequencies used are 9,009 and 9,725, the first one being by far the best.

INDONESIA. The Voice of Indonesia has been heard at good strength on 9,585 with its English programme to South East Asia.

CUBA. Radio Habana Cuba transmits in English to Northern Europe from 2010-2140 on 15,155; to South America 2050-2150 on 15,135 and to North America 0300-0430 and 0500-0600 on 11,865.

CZECHOSLOVAKIA: Radio Prague's English transmission to New Zealand, Australia and the Far East is broadcast from 0800-0855 on 9,503, 15,235, 15,285 and 21,450.

CANADA. The latest English schedule of Radio Canada reads as follows — To Europe, U.S.A., and Caribbean: 1215-1313 and 1516-1529 on 17,820 and 15,320. The second transmission is a news broadcast only. To Africa: 1832-1914 on 17,820, 15,320 and 11,720. To Europe: 2115-2150 on 15-320, 11,720 and 9,630. To Caribbean, U.S.A. and Latin America on 15,190, 11,760 and 9,625. To Australasia: 0725-0835 on 9,625 and 5,970.

SWITZERLAND. The Swiss Broadcasting Corporation has retimed the Australia and New Zealand transmission to 2100-2230 with frequencies of 11,865 and 9,545. "Swiss Shortwave Merry-go-round" is now broadcast at 2130 on Saturdays.

Other English broadcasts from the S.B.C. are —To Japan and South East Asia: 1315-1415 on 17,845, 15,320, 15,305 and 15,255. To Near East and Middle East: 1500-1600 on 17,830, 15,305, 15,255 and 11,865. To Africa: 0830-0930 on 17,830, 15,305 and 15,225.

Looking at . . .

ELECTRONICS IN MEDICINE

Part II

In the last issue we dealt with implantation, by operation, of an electronic pacemaker to assist a defective heart perform more normally. It was indicated that the usual operative dangers were present, particularly if the patient was elderly.

There is always an unwillingness to operate for purely investigative purposes and the same imposition applies to elderly people where the strain of a "probing" operation would prejudice the outcome of a "surgical" operation. Medical scientists have long been keen to study the functioning of internal organs without attendant surgery. Allied to this has been the desire to study an internal change of condition post-operatively.

Fortunately, many body organs provide signals that can be received by external apparatus: the heart can be heard (phonocardiography) or its voltage measured (electro-cardiography); brain impulses can be measured (electro-encephalography) and, more recently, muscle voltages can be detected and measured with only simple operations requiring local anaethestics.

Older methods involving X-rays have also been updated with radio active tracers but there are many areas in the human body where—until the advent of the transistor—the only contact was by operation or the swallowing (or insertion) of electrical leads to reach the desired location.

The Radio Pill

The small size and low battery drain of transistors were immediately obvious as aids to medical instrumentation and the use of a transistor in a small transmitter package inside the body was first attempted by R. S. Mackay at the University of California in 1952. This attempt was not successful and he then investigated passive, rather than active, pills. At this stage it would be as well to briefly classify the three types of radio pills :—

Active Pills. These are transmitters employing a transistor and circuit components (L, C and R) and containing a battery. Active pills can have an external power supply supplied by induction.

Passive Pills contain only L, C and R employed in a resonant circuit sensitive to the state to be studied.

Slave Pills in which an external field triggers off the pill to perform some specific function when the pill has reached the desired location. Slave pills are usually passive and one such is described later.

Sensitivity to Variables

The three variables of special interest in the internal tracts are temperature, pressure and pH (acidity or alkalinity). The other variable—rate of movement—can be plotted externally by tracking a pill.

Bearing in mind that the pill has to be small enough to be reasonably easily swallowed and lacking any major shape changes or apendages which could cause internal discomfort or blockages it is obvious that all the electronic and measuring functions must be contained within the single capsule.

Figure 1 is of a basic radio pill configuration designed to operate at about 500 Kc/s and L1 C1 determine the oscillation frequency.

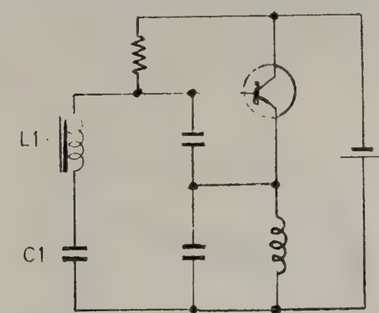


Figure 1

The measurement of our first two variables (temperature and pressure) is achieved quite easily by making the inductance L1 sensitive to the change. For temperature measurement the inductance can be wound on a bimetallic former so that the shape, and hence its inductance, changes or a similar principle can be used to vary an air gap in the inductance. Pressure can also be measured in a similar manner by using a pressure sensitive plate to move the core of a ferrite inductance.

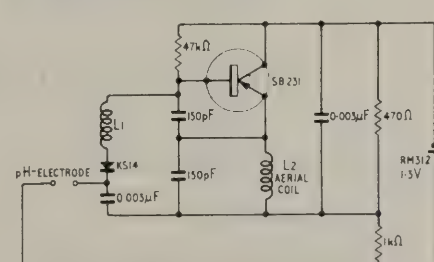


Figure 2

Figure 2 is the circuit of a practical radio pill used to measure pH but the values would be similar for pressure or temperature measurement.

The measurement of pH presents something more of a problem in that no simple element responds directly to a change in pH value and in practice pH is measured as a voltage. The pH measuring electrodes can be considered as a cell having an e.m.f. of from ·05 to ·5 volt, which voltage is related to the pH of the liquid surrounding the electrodes, but with the subtle difference that the

internal resistance is upwards of 10 megohms. So as to impose a minimum load and also, to reduce temperature dependent effects, the measuring load on the cell should be several hundred megohms.

In standard thermionic valve techniques, such an imposition is not very difficult to achieve by using electrometer valves but transistors are usually low impedance high current devices.

Wolff, McCall and Baker (2) describe a useful circuit based on the change in capacity of a silicon diode when the reverse bias on the diode is increased. Such a feature has the additional property, important in this case, of very low reverse currents (i.e., high impedance).

The capacity of such a junction can be expressed

$$C \propto \frac{1}{\sqrt{V + a}}$$

V being the reverse bias in volts and a is between ·6 and ·8 volts.

Figure 3 shows the curve for a. Such a relationship would be obtained from a GEC SX82 diode. The authors of the above paper obtained figures for a wide range of diodes and junction capacities (at approximately —1 volt) ranged from 20 pf to 800 pf in 12 types and reverse currents were in the order of 10^{-10} Amp or better. With a cell voltage of ·1 volt applied across the measuring input, a load of 1000 megohms is given.

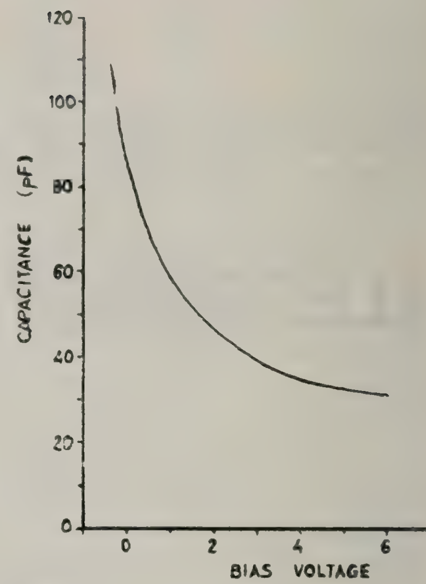
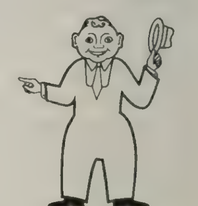


Figure 3

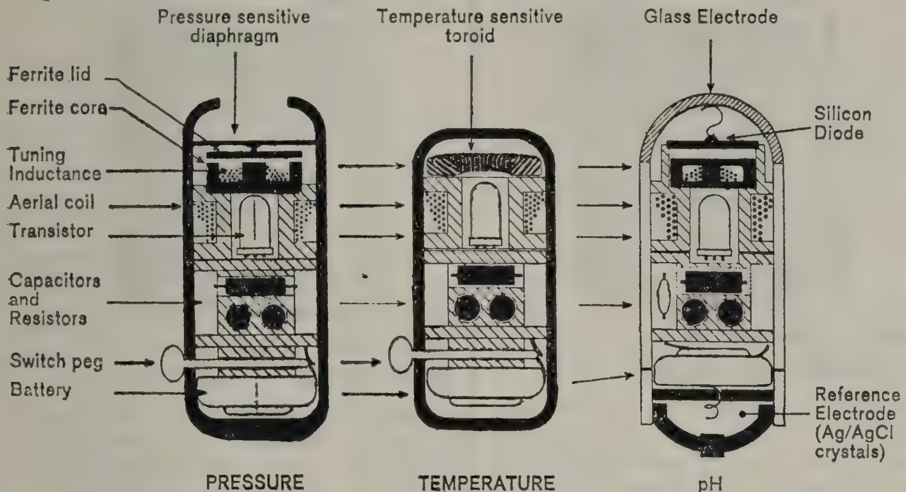
The basic circuit of figure 1 has become a frequency modulated oscillator, modulation being derived from the pH cell voltage which varies the capacity of the KS14 diode in figure 2. The diode thus replaces C1 of figure 1 and is biased to non conduction by a voltage divider network. The electrode voltage is in series with



the bias but is short circuited for r.f. by the $\cdot003\mu F$ capacitor which is several times the junction capacity.

In practice a frequency deviation of 70 c/s per mV input can be obtained giving a "swing" of about 30 Kc/s for the usual range of pH values.

the transmitted signal from the pill is not difficult provided an efficient system of loop aerials is used but tracking of the pill from the radiated signal alone may be difficult as the pill not only travels in a x-y plot but also in z (depth) and this last may reduce the received signal strength.



Cross-section of three pill types. Note the similarity in internal layout to facilitate quantity production.

Figure 4

Typical Pills

Figure 4 shows the construction of three pill types. Similarity in construction is made so that mass production methods can be employed. Typical pills are about $\frac{7}{8}$ inch long and $\frac{3}{8}$ inch in diameter. Batteries used give a life of around 35-40 hours. The switch peg shown is withdrawn just before swallowing and the hole sealed.

The temperature pill shown uses a recent development as the tuning inductance. A toroidal coil is wound on a strip of nickel/iron alloy having considerable changes in magnetic properties over the temperature range involved. Deviations of 10 Kc/s per degree C. are possible.

Providing the state measured does not change rapidly, the frequency change can be determined by standard receivers, as for a slow change the transmission is C.w and is likely to become truly F.M. in only a few situations.

Tracking Problems

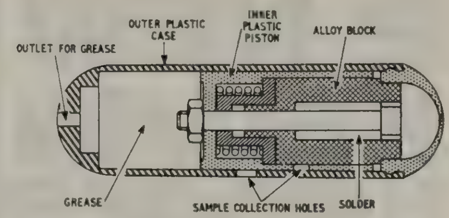
To obtain true value from radio pills it is necessary to know the exact position of a pill within the body at any time. Reception of

Several electro mechanical plotting tables have been devised to automatically plot the travel of a pill. However, such plotting can only be of real use when allied with a knowledge of the intestinal dimensions and routes within the body. Here, X rays with opaque powders to give intestinal outlines have been used but the problem remains a major one. One solution is the use of radio active tracer elements in the pill to give a plot on a "film" placed under or above the patient — but this would need to be used with caution so as not to produce radiation damage in the body.

A Special Pill

A recent development in passive pills has been a "sampler" pill used to obtain a sample from the gastro-intestinal tract and is shown in figure 5. The pill case has three holes at 120° radial spacing identical to those in an inner plastic piston. A block holds a spiral spring back in compression by solder. The L.H. cavity is filled with an inert (silicone) grease used to slow the eventual travel of the piston.

When the pill is in the desired position the whole patient is in-



Pill designed to collect samples from intestinal tracts

Figure 5

serted in an H.F. coil (at about 1 Mc/s) and 1 Kw is applied. This energy heats the alloy block to about 50° C. allowing the special solder to melt into the R.H. end cap. The spring is thus released allowing the piston to travel forward drawing up samples through the holes which are finally closed at the end of the travel.

Radio pills offer a wide open prospect in the field of diagnostic medicine and are an example of mass production techniques applied to an application not in itself demanding large scale production.

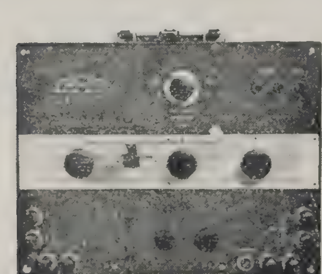
So far, we have discussed conventional equipment — conventional in that the units are based on standard components and tried techniques. Next month we will deal with lasers which are quite new but are having greater impact on the medical field than transistors did when they first appeared.

ENQUIRY CARD AD. 14

2 NEW KELVIN BRIDGES

4288 COMPACT D-C KELVIN BRIDGE

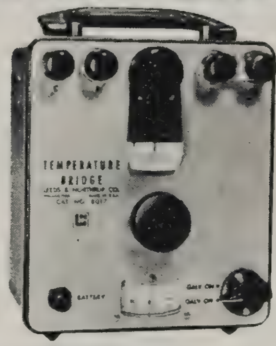
For rapid testing of low-resistance wires, rods, carbon brushes, windings and other electrical conductors. Range, 0.0001 to 11.00 ohms. Limit of error, ±1% of reading. Completely self-contained, with batteries and galvanometer. Metal case with handle, 7" x 6" x 5"; Weight, 5½ lb.



4287 PRECISION D-C KELVIN BRIDGE

For measurement of low-resistance . . . wires, rods, windings, resistors, etc. . . . with laboratory accuracy. Range, 0.0001 ohm to 110.100 ohms. Limit of error, ±0.05% of reading or better. Completely self-contained, with batteries and light-beam galvanometer. Metal case with handle and slip-hinged removable lid, 14¼" x 11½" x 7½" overall; Weight, 23½ lb.

2 NEW TEMPERATURE BRIDGES



8017 COMPACT D-C TEMPERATURE BRIDGE

For measuring temperatures using resistance thermometer detectors; e.g., in heating ventilation, refrigeration, etc. Any range suited for detector: minimum span, 20°F (11°C). Limit of error, ±0.3% of range. Completely self-contained with galvanometer, batteries and binding posts for connecting three- or four-lead Thermohm® elements. Metal case with handle, 7" x 6" x 5"; Weight, 4½ lb.

8064 D-C RESISTANCE THERMOMETER BRIDGE

For precise temperature and temperature-difference measurements with resistance thermometer detectors. Range, 0 to 160.1 ohms. Limit of error, ±0.05% of reading or 0.005 ohms. Completely self-contained with light-beam galvanometer, batteries and binding posts for connecting three- or four-lead resistance thermometers to bridge. Metal case with handle and slip-hinged removable lid, 14¼" x 11½" x 7½" overall; Weight, 20½ lb.

2 NEW WHEATSTONE BRIDGES

4283 COMPACT D-C WHEATSTONE BRIDGE

For wide-range resistance measurement in plant or laboratory. Covers 0 to ∞ ohms in six ranges. Limit of error, ±1% of reading. Sensitivity, 1% or better when measuring resistances between 0.3 and 300,000 ohms. Completely self-contained with galvanometer, batteries and binding posts for connecting external standards for ratio measurements. Metal case with handle, 7" x 6" x 5"; Weight, 4½ lb.

4289 PRECISION D-C WHEATSTONE BRIDGE

For general resistance measurements with laboratory accuracy. Range, 1 ohm to 11.01 megohms. Limit of error, ±0.05% of reading or better. Sensitivity, better than 0.05% for measurements up to 1 megohm. Completely self-contained with light-beam galvanometer, batteries and central readout. Metal case with handle and slip-hinged removable lid, 14¼" x 11½" x 7½" overall; Weight, 21 lb.

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MOBILE COMMUNICATIONS

Part III

by Countryman

For many years the mobile radio telephone field has been thought of as sort of half a step above the car radio market. For this reason most of the sets available have been built down to a price rather than up to a standard, and as far as my experience goes most of the sets on the market have lots of defects. To put it another way they have not been engineered for the job they have to do. Good circuitry is thrown away on flimsy construction, solid construction has been disgraced by poor and second hand components, and good components have gone into sets of poor layout and unpleasing appearance. If this sounds like a sweeping condemnation of the manufacturers let me direct you back to the second sentence. Building down to a price has been forced on the makers largely because the customer has not been persuaded of the advantages of buying good equipment. This surely is in the hands of the service agent. Manufacturers do not want to produce bad sets, and those I have had dealings with are only to anxious to put things to rights when a defect is pointed out to them. But how many of you make a point of telling them what you want in the next set?

I am going to devote the rest of this article to describing the mobile set I want to see in use. If you do not agree, or if you have other ideas let me know. I will be interested and I am sure most of the makers will be too!

PHYSICAL

The ideal set is completely self-contained, with the exception of the microphone. In addition to a built-in speaker it will have provision for an external speaker. It is completely sealed so that dirt, dust and moisture cannot enter. ALL connections should be in the form of sliding contact plugs on the mounting tray, so that it can be installed and removed by unskilled labour. If you don't think that this is important try travelling 70 miles to clean a main transmit relay (5 minutes work) and sending a bill for £12. (Made up of 140 miles at 1/- per mile and 5 hours at £1 per hour). I can assure you, that customer would have preferred to pay more for a set that didn't leak dust. In addition a simple plug—in set could have saved an expensive service call because the customer could have sent the set in by bus and re-installed it (or a spare) when it came back, saving about £10.

CONTROLS

Give a designer free reign and he will end up with so many knobs that the unskilled operator will at best be frightened off, or at worst misadjust the set so badly that he cannot get satisfactory results. A radiophone should be no more difficult to operate than an ordinary telephone. Fortunately most designers have seen the light and have started to reduce the number of controls readily accessible to the operator. For a single channel set there need only be an on-off switch, a mute on-off switch, perhaps combined with the volume control, and a push to talk switch on the microphone. With the new quick heat valves in the transmitter even the transmitter-standby switch is now no longer needed. In my experience the panel mounted variable mute or squelch control is easy to misadjust and is likely to result in poor operation. A well designed mute circuit should be sufficiently stable to go for long periods without any adjustment, and all that is needed is an on-off switch for marginal conditions.

AUDIO OUTPUT POWER

One of the disheartening aspects of mobile design is to see a set in which the designer has spent a lot of time getting good sensitivity and generally clean output, only to spoil it all by providing a miserable one watt of audio power into a tiny speaker of the type that any self respecting portable radio manufacturer would consider twice, before using. You might get away with this in a quiet car in city streets, but when you have a noisy truck on back country roads with the set mounted under the dash where noise is at its highest, well it just isn't satisfactory. I think you need at least three watts into a nice big speaker preferably mounted close to the drivers ear. Even where conditions are good, one watt is not enough, and the speaker is likely to be overloaded, with the reduction in clarity, that that this creates.

SET LAYOUT

Have you noticed the number of sets on the N.Z. market that have been designed for Left hand drive cars? You can always pick these, microphone sockets on the left, power connections also on the left. Apparently nobody noticed this when the set was designed.

As a result the connections are hard to get at and the microphone cord has to stretch across the set right to the other side of the car. And of course, if you have a set designed for left hand drive cars, you may end up with a right handed microphone, that is one where the pressel switch is depressed by the thumb when you hold it in the right hand. Of course in N.Z. you have to hold it with your left hand. Tricky, isn't it?

INTERFERENCE SUPPRESSION

In a previous column I touched on the subject of interference as it affects mobile radiophones. One recently developed method of combating this is called the "Pre-I.F. noise silencer", or "noise gate," as it is sometimes called. Because of the selectivity of the I.F. amplifier, noise pulses from ignition systems, although of relatively short duration, become lengthened when passing through the set, un-

ENQUIRY CARD AD. 15

Advance

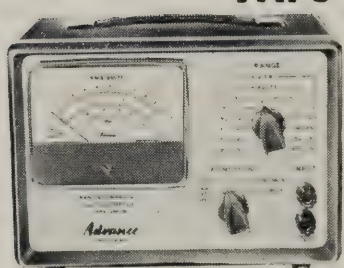
millivoltmeters & transistor tester

VM77B

A.C. Millivoltmeter

Voltage ranges 0·001, 0·003, 0·01, 0·03, 0·1, 0·3, 1, 3, 10, 30, 100, 300V F.S.D. *Frequency range* 15c/s to 4·5Mc/s. *Accuracy* ±3% F.S.D. 15c/s to 2Mc/s, ±(3% + 3% F.S.D.) 2Mc/s to 4·5Mc/s. *Accuracy* ±(3% + 3% F.S.D.) 2Mc/s to 4·5Mc/s. *Accuracy* ±2dB. *Input impedance* 10MΩ, 20pF (approximately 60pF using lead PL50 supplied. Lead PL45 is available as an accessory with 10: 1 capacity divider fitted). *Stability* ±1% for supply variations between 105 and 125V or 210 and 250V (15c/s to 2Mc/s). Less than 1·5% at 100V and 200V. *Non-sinusoidal operation* Readings close to r.m.s. values are given even when the harmonic content of the input is high. *Amplifier* Gain 60dB maximum in 10dB steps. Maximum output 1V r.m.s. Frequency response ±2dB, 12c/s to 200kc/s. Response from 200kc/s to 5Mc/s depends on load. Output impedance 1500Ω approximately. *Power requirements* 100 to 125V, 200 to 250V, 50 to 60c/s, 30W. *Dimensions* 8⅞in (23cm) wide × 6¼in (17cm) high × 5½in (14cm) deep. *Weight* 7lb (3·2kg).

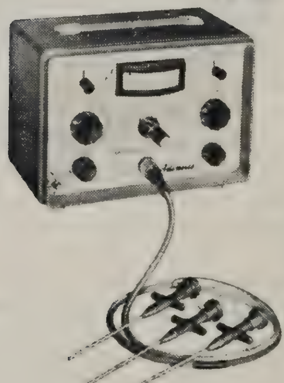
VM78



Battery-operated Transistorised A.C. Millivoltmeter

Voltage ranges 0·001, 0·003, 0·01, 0·03, 0·1, 0·3, 1, 3, 10, 30, 100, 300V. *Overload protection* Protected for inputs up to 400V peak on 0·3V and higher ranges, and for 100V r.m.s. on 0·1V and lower ranges. *Frequency range* 1c/s to 1Mc/s. *Accuracy* ±3% F.S.D. *Input impedance* 2MΩ shunted by approximately 30pF. *Temperature range* 0 to +45°C. *Noise* Less than 50μV referred to the input, when terminated in 47kΩ or less, on the 0·001V range. Residual reading less than 3% of F.S.D. on all other ranges. *Dimensions* 8⅞in (22·5cm) wide × 6½in (16·5cm) high × 5½in (14cm) deep. *Weight* 6·6lb (3kg).

TT1S



Transistor Tester

Battery operated for testing p.n.p. or n.p.n. transistors in situ.
Current gain (*Beta*) 10 to 100, 50 to 500. Accuracy with transistor out of circuit, ±5%; with transistor in circuit, dependent on base shunt circuitry. *Set current* Nominally 1 to 50mA (dependent on shunt circuit). *Balance* Shunt collector circuits of greater than 100Ω can be balanced out by the instrument. *Leakage current measurement* (grounded emitter I'co) 0 to 100μA and 0 to 1mA, with transistor out of circuit. *Diode measurements* Reverse leakage measurement as for I'co. With 10mA of forward current, meter will indicate voltage drop across diode (2V F.S.D.).

Dimensions 8⅞in (22·6cm) wide × 6½in (16·5cm) high × 5½in (14cm) deep. *Weight* 6¾lb (3·1kg).

ADVANCE ELECTRONICS LIMITED ENGLAND

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FROM THE COMPREHENSIVE RANGE OF Advance INSTRUMENTS AND EQUIPMENT

til they become very much more apparent to the ear. At the same time they also get delayed, and the Noise Gate is based on the idea of detecting the pulse at the mixer, amplifying it, and using it to cut off the signal, before it gets into the I.F. amplifier. I have heard one of these working in an imported mobile, and there is no doubt that it can be most effective in cutting out ignition interference without any apparent degrading of the signal. This system has the makings of a big advance over the conventional limiter used in mobiles, and it is to be hoped that it will not be too long before they are incorporated in N.Z. designed equipment.

You may have noticed that so far I have not quoted many figures, nor have I said anything about the desirability of transistors as opposed to valves. You can put this down to low animal cunning if you like, but any figures I could quote today could be out of date by the time this is read. As far as valves and transistors are concerned, as someone said to me the other day "They can use coherers and decoherers for all I care, so long as they meet the specification and we can get spares for the next ten years."

It seems to me that the days of both the valve and the transistor are numbered. We are already seeing the trend towards "modular" construction, and this will no doubt become much more commonplace. Already some manufacturers are producing sets with a standard type of I.F. amplifier on a printed card. The correct type of response is chosen by the input filter, which can be changed to suit the type of service. In the event of failure the card is simply disconnected (six connections) and replaced with a new one. Of course this may not be as cheap as hunting the faulty component and replacing it, but often time is a much more valuable commodity than mere cash, in the middle of a forest fire for instance. But we are now getting into the question of costs, and that, to coin a phrase, is another story.

ATOMIC FREQUENCY STANDARDS

Continued from page 13

pumped continuously by fast vacuum pumps. Temperature control, and magnetic shielding of the relatively large cavity is something of a problem also. The final apparatus turns out to be fairly large and complicated, although at least one firm has recently produced a commercial version.

The wall coating of the cell, or bounce box as it is sometimes called, produces a frequency shift

The wall coating of the cell, or bounce box as it is sometimes called, produces a frequency shift of several parts in 10^{11}; but hydrogen masers using the same wall coating material reproduce the same frequency to 1 or 2 parts in 10^{12}. However the actual precision of comparison can be as high as a few parts in 10^{13}. The hydrogen maser is therefore a very remarkable device, but to fully realise its potential, some work still needs doing to try to reduce the wall shift which, although small compared with similar effects in the optically pumped gas cell, is nevertheless 100 times larger than the precision with which the maser can be used.

It is known that NASA is at present evaluating the hydrogen maser for use in space experiments involving relativity theory.

The New Second of Time

Finally, attention is drawn to the proposed new definition of the second of time interval which the Bureau International Des Poids et Mesures in Paris has recommended should be redefined in terms of the frequency of the electromagnetic radiation corresponding to the transition between two well defined energy levels of an atom or molecule; and that the definition should anyhow correspond to the presently accepted value of 9192631770c/s assigned to the well defined caesium transition, in the absence of external perturbing fields.

In practice however, the atomic second has been in use at the unit of time interval since Essen operated the first atomic clock in 1955.

RECIPROCAL LICENSING CONCESSION IN THE U.K.

The British Postmaster General has recently stated that he will in future grant amateur radio facilities in the U.K. to nationals of countries which are prepared to grant similar facilities to British amateurs.

Reciprocal licensing of this type is a major concession which has been sought by the R.S.G.B. for many years and will help to strengthen still further the ties of international friendship between the world's 350,000 amateurs.

It follows the introduction of similar facilities in the U.S.A. and in a number of European and other countries.

\+ \+ \+

LENGTHY AERIAL

A radio aerial 22 miles long is to be used at the Byrd research station in Antartica for very low frequency experiments during the International Year of the Quiet Sun.

TAPE TOPICS

Continued from page 15

the tape runs from left to right, move the playback head up, then lower it until output (on the left channel in the case of stereo) reaches a maximum. If the tape runs right to left, lower the playback head and then raise it until output reaches a maximum. If the deck uses a separate record and playback head, then first align the playback head, then adjust the record head for maximum output while simultaneously recording and playing a low frequency tone.

The erase head is aligned last by adjusting it for maximum erasure of a tape recorded at high level.

For four-track stereo heads, the alignment is more critical, as a final check between channels for cross talk is also necessary.

Do not forget that once the height alignment is completed it is still necessary to check for correct azimuth alignment as described earlier.

N.Z. ELECTRONICS INSTITUTE
WEEKEND ANNUAL CONFERENCE

Date: July 10th and 11th, 1965.
Members and Prospective Members cordially invited.
Venue: National Airways Buildings, 44 The Terrace, Wellington.

PROGRAMME

Saturday, 10th July—
Morning: Annual Meeting of Institute.
Venue: Industry House, Courtney Place, Wellington.
Afternoon: Symposium and Discussion on the Development of the N.Z. Electronics Industry.
Chairman: Mr. W. Strong.
Paper by M. L. Fuller, Managing Director of E.D.A.C.
"The Aspiration of the N.Z. Electronics Industry."
Paper by Mr. E. W. De Lisle, Superintending Engineer, G.P.O., Wellington.
"What the User expects from the N.Z. Electronics Industry."
Paper by Mr. G. L. Easterbrooksmith, Director of the Development Division, Department of Industries and Commerce.
"The Govt. Policy as it affects the N.Z. Electronics Industry."
After the Papers, the Chairman will open the subjects to discussion.
Saturday Evening: Social evening.
Venue: English Speaking Union, Nathan's Bldgs., Grey Street.
Sunday, 11th July: Visits have been arranged to N.Z.E.D. Substation at Haywards, and N.Z.B.C. Transmitting Station at Titahi Bay.
Fees: For Weekend £1 Single, £1/10/0 Double.
For registration or for further information contact the Convention Convenor, N.Z. Electronics Institute, P.O. Box 5106, Wellington.

ON OUR BOOKSHELF

A new publication we have for review this month is "**Analog — Digital Conversion Handbook**". By Barbara W. Stephenson, this book is produced and published by Digital Equipment Corporation, Maynard, Massachusetts. This book is an attempt by an industrial firm concerned with the data processing industry, to assemble a considerable amount of fairly comprehensive information on the subject of Analogue to Digital conversion, in a form that makes it useful to both the student and the experienced engineer. The book successfully covers most phases of conversion techniques, from first principles and concepts, to calibration of operational converters.

In addition to the subject of Analogue to Digital Conversion, the reverse phenomena, i.e. Digital to Analogue Conversion is also discussed.

There are seven chapters entitled—Basic Elements of Conversion; Meaures of Converter Performance; Special A to D Conversion Techniques; Typical Converter Logic; Basic Circuits; Interconnection and Calibration; and Testing an A to D Converter.

The text is well illustrated, and together with a number of tables summarising terms, methods and performance characteristics. the various chapter outline circuit modules and other equipment, which although obviously bearing the product name of the publisher is sufficiently basic to provide useful design data and instruction.

This book can be procured by application to the above mentioned firm who are to be congratulated on a very useful and practical publication.

The second book we have for review is entitled "**TV Sweep Alignment Techniques**". By Art Liebscher. Published by J. F. Rider, Inc. New York and Chapman & Hall Ltd., London.

This book will prove useful to all those who utilise sweep alignment techniques for research, development or servicing of TV and other wide band amplifying equipment. Nowadays most of the TV service notes show typical sweep response curves, and the proper understanding of these curves, how they are obtained and what incorrect curves mean, can shorten the time taken in both design laboratories and service workshops.

The first two chapters of this book introduce and discuss modern sweep alignment techniques. The third chapter discusses the use of markers, together with the use of the equipment producing the markers; whilst the fourth chapter introduces a new topic — the technique of the super-mark. This principle is based on a system of the utilisation of the superhet principle in reverse.

Chapters 5, 6, and 8 deal first with sweep curve production and presentation, tuner curve formation and I.F. curves and adjustment proceedures.

Chapter 7 discusses I.F. chain alignment procedures and Chapter 9 utilises the same approach to the Sound I.F. and Sound detector.

The last two chapters encompass somewhat more specialised applications. Chapter 10 is concerned with Swept Oscillator response testing of Video Amplifiers. whereas Chapter 11, entitled U.H.F. Sweep Alignment discusses some of the similarities to V.H.F. tuner alignment together with the problems associated with this portion of the receiver. Whilst not really applicable in this country yet due to the absence of any commercial U.H.F. TV systems, this chapter makes a tidy conclusion to the book.

The short but adequate index at the end of the text will provide a quick reference guide.

As can be appreciated, this book is written in the U.S.A. and most actual data references are made to the American system. Nevertheless, the techniques are almost directly applicable to the system in use in this country.

Our copy by courtesy of Technical Books Ltd.

STEREOPHONY — by N. V. Franssen, translated from the Dutch by G. du Cloux. English edition 1964. Published by Philips Technical Library.

Stereophony is defined as "the giving of perspective to our hearing of reproduced sounds." Thus although the title is a word having to do with the stereophonic recording and reproduction of sound, the book itself is not primarily concerned with the technicalities of "stereo". Rather it covers various aspects of hearing, mainly auditory perspective, that is, the ability to perceive the direction of a sound source.

Like so many subjects when closely examined, one finds there is more to it than meets the eye. We all know that it is necessary to possess two ears in order to sense the direction of a sound source but just how this binaural function is obtained is a subject of conjecture.

The author discusses briefly four theories which have been put forward in explanation of this phenomenon. There is also a chapter on room acoustics which includes reference to reverberation times and reflected sounds and makes brief mention of artificial "reverb".

Our copy from Philips Electrical Industries of N.Z. Ltd.

—J.W.S.

ENQUIRY CARD AD. 22

PHILIPS GENERATORS

LF GENERATORS

type	frequency range	accuracy	range	max. distortion	max. output
PM 5100 L.F.	15 c/s – 150 kc/s	5%	4	0.5 – 1%	10 V

PROFESSIONAL TELEVISION GENERATORS

type	TV system	pattern/frequency	max. output
GM 2671 pattern	CCIR, British 625, FCC, French 819	Chess-board	1 V
GM 2681 VHF	CCIR, British 625, FCC, OIR and special versions	TV channels 2 to 11	100 mV
GM 2682 VHF	any system with FM sound and neg. picture modulation	one of TV channels 2 to 11	1.5 V (modulated)

TELEVISION SERVICE GENERATORS

type	TV system	bands	pattern	output
GM 2892 pattern	CCIR, FCC, OIR, France, Belgium	I, III, IV, V	hor. and/or vert. bars	20 mV, 5 mV

MODULAR PULSE GENERATOR—an extremely flexible pulse generator system providing a variety on one or several channels

type	name	main characteristics
PM 5720	master generator	10 c/s – 10 Mc/s, external d.c. – 15 Mc/s, single shot/remote control
PM 5722	short delay/width unit	range 10 nS – 1 mS
PM 5723	long delay/width unit	range 1 μS – 1S, external gate output, facilities for modulation of pulse delay-width
PM 5725	interpulse unit	for additional setting of pulse delay/width in connection with PM 5723, range 1 μS – 1 S
PM 5732	AND – OR gate	mixer and AND-gate for system needle pulses
PM 5727	output unit	output 5 mV – 5 across 50Ω, rise and fall time <10 nS, true positive and negative pulses simultaneously available
PM 5740	power supply unit	110 – 245 V, 50 – 60 c/s

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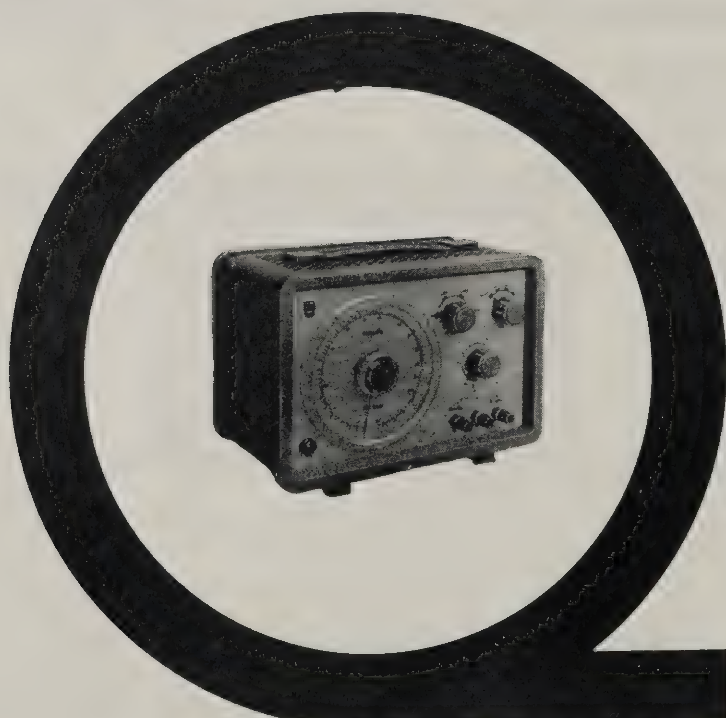

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Auckland Group V.H.F. Convention

The Auckland V.H.F. Radio Group held its fourth Annual Convention throughout the week-end of April 9th to 11th. All functions were held in the main hall of the Museum of Transport and Technology at Western Springs, Auckland.

The weekend opened on the Friday night with a well attended social enabling many of the 70 attending to become acquainted. On the Saturday morning, the programme commenced with some antenna measuring trials. With the co-operation of the N.Z. Post Office any convention participant could bring along his pet type of antenna for performance evaluation on the antenna measuring range. From the aerials submitted a great deal of interesting results were produced.

After morning tea the V.H.F. Mobile Rally was sent away. All of the 12 competing vehicles completed the 1½ hour pleasant and interesting course through the Waitakere Ranges. One highlight of the trip was an enforced stop for a few minutes to view the new 400 foot mast and antenna system erected for AKTV2. During this event the Convention Station ZL1BQ operated as Base station for the rally from the Communications Hall in the Museum. This event was won by the team operating ZL1MQ with 95 points. Second place was awarded to the ZL1AGV team, whilst the ZL1AMN team was third. Following luncheon and official photographs the more serious side of the convention was embarked upon. After a short speech of welcome, the chairman, Mr. D. Johnson ZL1AMN declared the convention open and introduced the first guest technical lecturer, Ft. Lt. Ian Woodmore, officer-in-charge of Communications R.N.Z.A.F. Station Whenuapai, who gave a very interesting lecture on the new Decca Surveillance Radar to be installed shortly at Whenuapai.

At the conclusion of afternoon tea, principal scientific officer Mr. Peter Barker of the Naval Research Laboratory presented a very interesting lecture on V.H.F. telemetry systems.

In the evening, the convention dinner was enjoyed by all, and followed by an evening of light entertainment interspersed with the presentation of awards, prizes etc.

Sunday morning opened with a Technical and General Forum to enable many matters of interest to be aired and discussed. After morning tea Mr. Theo Goodare brought the convention to a close with an interesting but informal talk on his recent visit to the U.S.A. as part of a team sent by the R.N.Z.A.F. on a familiarisation course to study the electronics and instrumentation of the Hercules aircraft. Whilst in the United States Mr. Goodare was able to visit many of the electronics establishments and the American Radio Relay Leagues' West Coast Convention.

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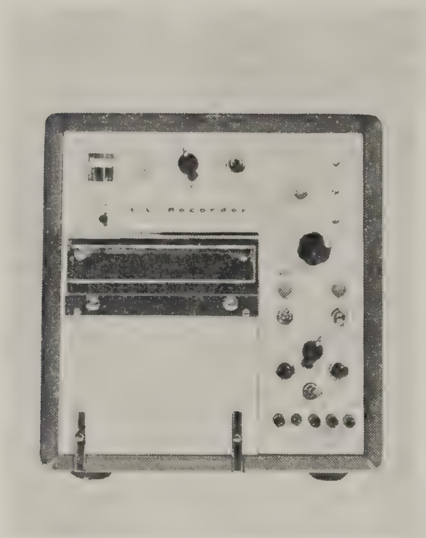


MEASURING PARAMETERS

U.V. Recorders, register, on direct print-out ultra violet sensitive paper, the output from electronic peripheral equipment, thermocouples and d.c. energised strain gauges. Direct electrical signals from voltage and current sources may also be recorded. Three basic sizes are available, recording on paper widths of up to 150mm, 200mm and 300mm, accept the output from up to 6, 12, 25 or 50 individual channels, and produce traces at writing speeds of up to 1000 M/sec.

The recorders project an ultra-violet light beam on to a bank of galvanometers which deflect the light through an optical system to produce individual light spots on the recording paper. Fifteen different paper feed speeds from 1.25 to 2000 mm/sec. are possible. Calibration lines can be printed across the full width of the recording paper at selectable time intervals of .01, 0.1, 1 or 10 seconds. Grid lines (spaced at 2 mm. intervals with every fifth line accentuated) are produced optically during recording, thus compensating for paper drift during recording and subsequent paper shrinkage. Other facilities include a preset paper length control, paper contents indicator, trace identification system, magnet block heaters and a take-up unit.

For measuring mechanical parameters of pressure, displacement and acceleration, S.E. Laboratories transducers work on the principle of variable reluctance, whereby two coils are connected in the form of a half bridge, and the inductance of either one or both of the coils is varied by the mechanical parameter being measured.

Electronic peripheral equipment is available to provide transducers with suitable a.c. energising voltage (carrier wave) and to extract the phase-conscious d.c. signal from the amplitude-modulated carrier wave. The d.c. signal thus obtained is proportional to the magnitude of the mechanical parameter. Various types of demodulators and amplifiers are available, giving either voltage or current output at various power levels. These units are designed to work with both variable reluctance transducers and strain gauges bridges.

ENQUIRY 170

* * *

MIDGET ELECTRONIC PACKAGE

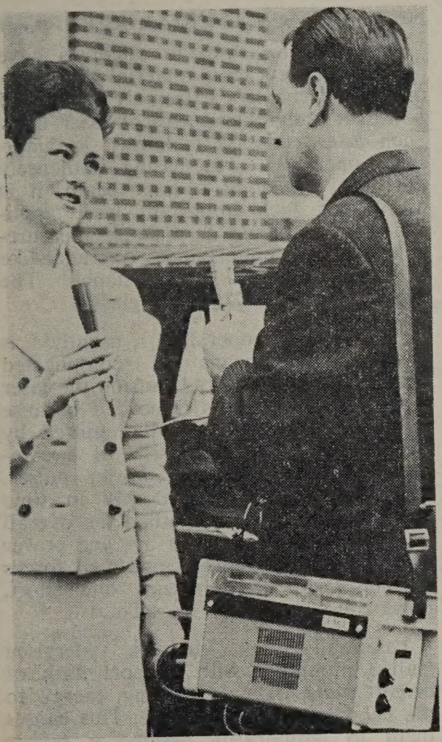
A pocket-sized electronic package designed for aerospace purposes may be equally as valuable for the foot soldier. The Westinghouse package could provide combat infantrymen with silent attack signals that defy enemy detection. But the unit — termed a command and control receiver — was actually built to evaluate new uses of molecular electronic components in aerospace equipment.

The miniature command and control receiver displays eight tiny lights which can be illuminated in various combinations to denote certain commands. The unit will also receive voice commands when radio silence is not necessary. An infantry leader would control the lights by means of a transmitter. Changes in signal light codes would make it impossible for an enemy to detect the meaning of messages if one of the receivers was captured.

ENQUIRY 164

PORTABLE PROFESSIONAL TAPE RECORDER

The new British L4 portable tape recorder, designed for use in the broadcasting field, is claimed to have five additional facilities over earlier models. It weighs less than 11 lbs.



EMI Electronics Limited offer the recorders in a choice of two speeds, remote control, press-button operation, mixing of two microphone inputs and the provision of a position for a fourth magnetic head for sound synchronisation in film work. In a tropicalised case and powered by a 14 volt rechargeable battery, the L4 tape recorder is available in half and full track versions. The lightweight alloy case measures 11¾ in. x 7 in. x 6¼ in. and has a transparent acrylic lid.

ENQUIRY 166

* * *

NEW INTEGRATED LOGIC CIRCUITS

Transitron have developed a comprehensive range of monolithic high level transistor — transistor logic (HLTTL) circuits.

This type of circuit is an improvement on earlier types since it has: Excellent noise immunity — better than 600 mV at 125°C; high fan out — minimum 20; low progagation delay — less than 10 nS; high capacitive driving capability — 300 pF.

Performance has been achieved with improved reliability by the use of advanced manufacturing techniques such as: extension of over-oxide metallisation (resulting in elimination of ion accumulation); accurate control of masking processes; improved chip layout design (assisting in the reduction of parasitic capacitance); use of VHF transistors (resulting in improved propagation delay and resistance to irradiation); use of all-aluminium lead-to-chip bonding (resulting in elimination of purple plague).

The range includes: Single 8 input NAND/NOR gates; dual 4 input NAND/NOR gates; dual 4 input NAND-OR (exclusive OR) gates.

The latest addition to the HLTTL range is a 20 Mc/s single phase d.c. coupled flip-flop, which, due to its design, makes it ideal for use as: Shift register element; J.K. flip-flop; counter stage; set-reset flip-flop.

All HLTTL circuits are available in either a multi-lead low height TO-5 package or ceramic-glass flat package.

ENQUIRY 160

* * *

ELECTRICAL BRIDGE BALANCED ELECTRONICALLY

An instrument developed by The Wayne Kerr Laboratories Ltd. of New Malden, Surrey, U.K. enables resistance, inductance and capacitance values to be measured without manual balancing operations. Known as Autobalance Adaptor AA221, (formerly Electronull Adaptor EA221) it operates in conjunction with the Wayne Kerr Universal Bridge B221. It can also be employed whilst the Low Impedance Adaptor is in use, making direct measurement available from 50 micro-ohms to 50,000 megaohms, 0.0002 micro-microfarads — 3 farads, and 0.005 microhenry to 1000 henrys. The AA221 is self-powered, has internal source and detector operating at 1592 cycles, and outputs available for operating recorders, digital voltmeters, printers and alarm systems or pass/reject mechanisms. Resistive and reactive terms of any unknown can be read simultaneously, without any interaction on the double meter display. Conductance and capacitance displays of the Bridge alone can each supply four-figure readings, the first two on separately switched decade controls and the others from a vernier control. The two meters on the AA221 effectively replace the Bridge vernier controls. By suitable choice of Bridge range these meters thus provide the entire reading or, in conjunction with the switched decades on the Bridge, the third and fourth figures. In either case the vernier controls are set to 0 and the final bridge is maintained electronically.

ENQUIRY 161

* * *

HIGH RESOLUTION "BROADCAST" VIDICONS

The range of English Electric Valve Company high resolution, separate mesh 1-inch vidicons, has been further extended with the introduction of two types having high peak response in the "blue" region of the spectrum. These tubes, the 8625 (P846) and 8626 (P847), incorporate entirely new photo-surfaces providing: Very high and uniform sensitivity, extremely low lag and reduced long term sticking characteristics, correct panchromatic response with tungsten illumination and high resolution at high signal currents.

Excellent signal uniformity is achieved with improved manufacturing techniques whereby photo surfaces are "prefabricated" to ensure an overall even deposition. Studio lighting levels may be considerably reduced due to the very short lag times promoted by the new photo surfaces. Extremely good reproduction of flesh tones is due to the well balanced spectral sensitivity of these vidicons.

The vidicons are eminently suited for live and telecine pick-up in both colour and monochrome television. The extra blue sensitivity gives a useful improvement in signal to noise ratio in colour TV cameras, and also promotes high signal output in applications where light with high blue content is used e.g. fluorescent lamps, natural daylight. The 8625 (P846) has a standard 6.3 V/0.6A heater, and the 8626 (P847) has the new low consumption 6.3 V/0.95A heater.

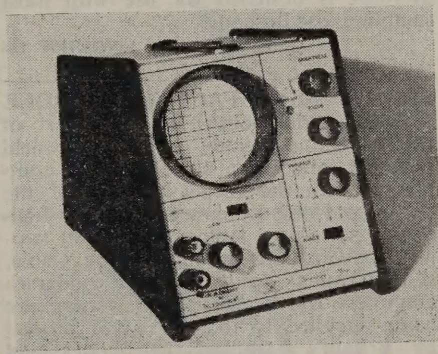
ENQUIRY 163

* * *

THE SERVISCOPE MINOR

The Serviscope Minor is capable of the visual presentation of results in many experiments in the teaching of basic physics, including experiments in mechanical quantities, acoustic quantities, DC quantities, AC quantities, etc. In spite of its small size the Serviscope Minor will also find many applications in radio servicing, hi-fi, recording, etc. where a basic general purpose oscilloscope is required.

A 2¾" CRT operated at 600V provides a bright fine trace. The green removable graticule is divided into 10 divisions, both horizontally and vertically, each division being 0.5 cms. A moulded rubber light hood is fitted as standard. The direct coupled vertical amplifier has a bandwidth of 30 Kc/s (—3dB) and has continuously variable gain control providing a sensitivity range better than 100 mV/division to 50 V/division. Input terminals are fully insulated from case and ground.



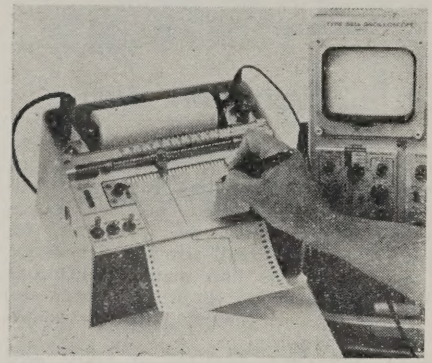
The time base is automatically triggered by any input signal of more than half division thus eliminating synchronising/triggering controls. Time base speeds can be varied from approximately 100 usecs/division to 100 Msecs/division by a 3 position switch with a variable control to provide continuous overlap between ranges. The time base may be switched off, when the undeflected spot will return to the screen centre.

The Minor weighs 5 lbs., with dimensions of 5¾" wide x 6" high and 9" deep. The instrument is suitable for operation from 200/250V AC 50 c/s supply. Power On warning light is fitted. Power consumption is approximately 25W.

ENQUIRY 165

SAMPLING SCOPE TRACES REPRODUCTION

The Nesco SR100A Sampling Oscilloscope Recorder reproduces an oscilloscope display on a 5" x 5" chart paper facsimile of the scope graticule which may be torn off for analysis, filing, or further reproduction. The method is faster than conventional X-Y recorders and oscilloscope cameras, and one-time calibration eliminates time-consuming set-up operations. Recorded traces represent the actual presentation to within ± 1%.



Reproductions can be made every 22 or 90 seconds, depending upon chart speed selected by panel toggle switch. Chart paper is perforated between each grid (every six inches) and has space to record vertical and horizontal sensitivity, date, serial number, and other pertinent information. The paper is suitable for diazo process reproduction. Grid and trace are easily reproduced by xerographic or photographic methods. The SR100A is designed for use with most sampling oscilloscopes.

ENQUIRY 168

ELECTRICAL LUBRICANT

Used on contacts, Electrolube 2A-X is said to prevent pitting and contact bounce, reduce arcing and improve conductivity. Supplied in bulk cans, aerosols, grease tubes, pen applicators and containers dispensing individual drops, the product is intended to reduce maintenance costs and ensure electrical reliability.

Industrial uses include application to contacts, relays, switches, potentiometers and busbars. Protection is provided against tarnish, corrosion and humidity. Dust is not attracted and electrolytic action is obviated. Application can be safely made on plastics, rubber and paint, it is claimed.

Available from P. H. Rothschild & Co. Ltd.

ENQUIRY 173

* * *

INTEGRATED CHOPPER TYPES ST.5610 TO ST.5614

Transitron have announced their new range of NPN silicon planar epitaxial integrated chopper transistors. These transistors, by means of revolutionised design and production techniques, feature performance characteristics better than those previously available. They are especially suited as choppers and demodulators in microvoltmeters and as level amplifiers in digital-to-analogue converters.

Typical parameters for ST.5610: High BV_{EEO} — 20 volts; low offset voltage — 30 microvolts; low dynamic resistance — 35 ohms; low drift — 0.3 microvolts/°C.

Advanced techniques incorporated include: Guard rings in the base region around each emitter to eliminate emitter-to-emitter channelling; emitter contact metal extensions over the passivating oxide layer to eliminate ion drift on the oxide surface; ultrasonic aluminium wire bonding to avoid purple plague at the chip.

The ST.5610 series is mounted in a 4 lead version of the JEDEC TO-18 package and is immediately available in prototype quantities.

ENQUIRY 157

* * *

NEW LASER MATERIAL REPORTED

Westinghouse research scientists have produced a new laser material that automatically generates extremely sharp and powerful individual pulses of laser light. Such laser emission is known as giant-spike operation. Increasing immensely the peak power of a laser beam, it is useful for such important laser applications as ranging, or distance measurement, and reconnaissance, or radar-like detection of objects at a distance. The new material is a type of glass.

Giant-spike operation usually is achieved by means of complicated optical apparatus placed outside the laser itself. The apparatus is needed because the pulse of light normally emitted by a laser rod actually consists of a complex array of separate, shorter pulses. These pulses occur randomly in time and their effect is to lengthen the overall laser burst and lower its average power level. External optical equipment forces the laser to emit instead one short, powerful laser pulse, or spike.

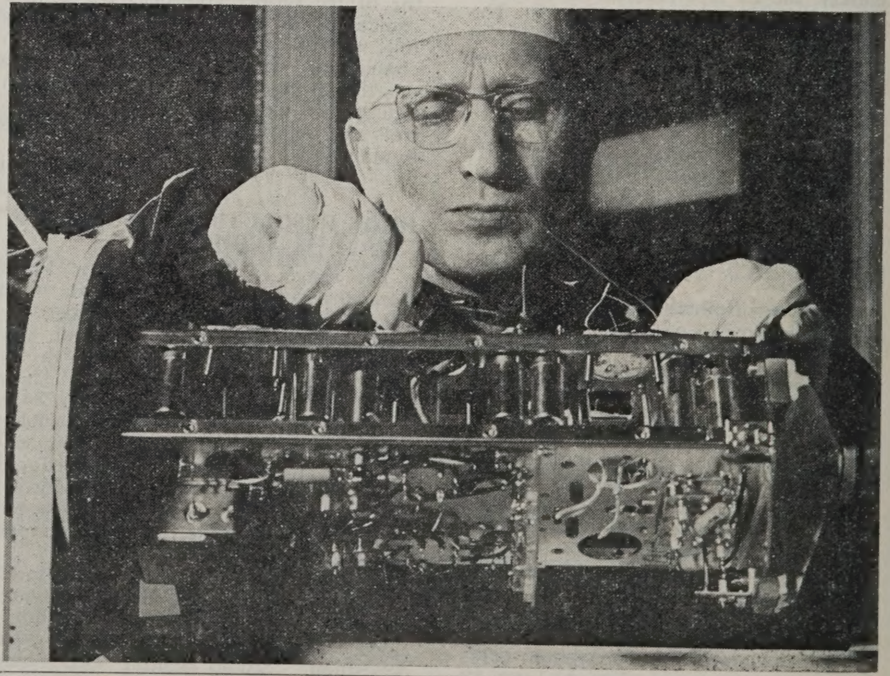
Essentially, the glass is energised (called pumping) with a short flash of bright white light — adding energy to the neodymium (glass) ions. This causes them to temporarily assume a higher energy state and then, within a fraction of a second, they return to their original state of lower energy, giving up the excess as a burst of coherent light. This light is bright, more directional, and more monochromatic than the pumping light.

ENQUIRY 159

BRITISH MANUFACTURERS' ROLE

Seacom, the South-East Asia part of the Commonwealth round-the-world undersea telephone cable, neared completion with the recent opening of the Sabah to Hong Kong section. The high quality telephone system carries 80 two-way conversations simultaneously. Cable, shore-terminal equipment and undersea amplifiers worth £8,000,000 sterling are being supplied to the SEACOM project by Britain's Standard Telephones and Cables Limited.

The next phase, between Guam and Cairns, Australia, introduces 160-circuit equipment instead of the 80-circuit system used in the Commonwealth cable so far. This equipment will also be built by the British firm.



Here, working in a dust-free atmosphere, a technician at a factory in London assembles an amplifier unit for a submarine telephone cable repeater.

The repeaters are placed every 26 nautical miles along an 80-circuit telephone cable and are designed for reliability. They are expected to operate continuously for at least twenty years on the sea bed without attention.

ENQUIRY 167

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